

# Railway Mechanical Engineer

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The coaling station is often a source of considerable trouble in the operation of a locomotive terminal. This is one of

## Some Defects of Coaling Stations

and the men in the mechanical department are directly concerned with its operation but they usually give little attention to the design of such plants and when new coaling stations are built, have little voice in the matter. An examination of typical terminals often shows defects in the coaling arrangement that could have been avoided if the requirements of operation had been more carefully considered. Some coaling stations are designed for unloading only one type of car. In emergencies other types must sometimes be used, causing embarrassing delays that might have been avoided by a slight change in the receiving pit. Another cause of trouble is the inadequate provision for spotting cars. Oftentimes the tracks are placed on a grade so that the cars can be moved with pinch bars. This is unsatisfactory, especially when snow blocks the track. A winch with sufficient power to move a loaded car under any ordinary conditions would avoid laboriously pinching the cars along the track, which is both inconvenient and costly.

Aside from a matter of economical handling, the design of coaling station may have a considerable effect on fuel economy. If much breakage takes place in the chute, the coal may be too small to burn efficiently or if the lumps and the fine coal separate, some locomotives may get all lumps and others mostly slack, neither of which will give as good results as a uniform mixture.

One of the most fruitful sources of deterioration of freight cars, irrespective of the material of construction, is corrosion or decay, which continuously exerts its destructive influence whether the equipment is in service or not. In the case of wood parts there are very few renewals which are not directly caused or at least greatly hastened by decay. Indeed, a close analysis of failures which appear to be purely mechanical will generally disclose the gradual destruction of the piece by decay as the original source of weakness.

The use of paint, to which preservative treatment is now generally confined, has no power to prevent the destruction of the material, by chemical action in the case of steel and by the propagation and growth of the destroying fungi in the case of wood, except by the mechanical exclusion of the offending elements. The preservative treatment of timber by impregnation with a solution (generally creosote or zinc chloride) which prevents the growth of decay, not by mechanical exclusion but by toxic action, has been extensively applied with excellent results in the case of ties and offers possibilities for increasing the life of the wood parts of freight cars the development of which is likely to increase very materially the economic advantages of wood construction in

freight car superstructures. It has already been applied to certain parts of refrigerator, stock and gondola cars by several railroads and although none of these applications have yet been in service long enough to determine the full effect of the treatment in prolonging the life of the equipment, it has already been demonstrated that this life will be much longer than can be obtained without such treatment.

No doubt considerable study will be needed before the full possibilities and limitations of the several processes of preservative treatment as applied to freight car material can be fully determined. Their application to such parts as sills, underframe, nailing strips, stock car decking, sheathing, posts and braces, roofing, running board saddles, gondola decking and sides, refrigerator car sub-flooring, and other parts, has demonstrated that the possibilities are extensive. The subject is worthy of much more serious consideration by car department officers than it has received in the past.

## Radical Innovations in Locomotives

No one who follows the development of the locomotive can fail to be impressed with the many designs embodying new and radical features that are now being built. For years turbine locomotives have been discussed in the technical press but the designs have not progressed beyond the drafting room. At present two turbine locomotives are in service and still more are being designed and will probably be built. Internal combustion locomotives likewise have been proposed many times but except for Diesel's experimental engine, no important locomotives of this type have been constructed. Hydraulic transmissions are now being tried and may overcome the difficulty of starting trains, which has been the stumbling block for the internal combustion locomotive. Apparently many of the unique designs which have been discussed pro and con for years will soon have an opportunity to prove whether they have advantages over the reciprocating steam locomotive that will justify their use.

It is still too early to judge the worth of the new types of motive power which are now being tested, in fact the experimental locomotives will not settle the question. In regular service a locomotive never gets the close attention that a new design receives on its trial trips and the fact that a turbine or internal combustion locomotive shows a considerable saving in fuel as compared with an ordinary superheated steam locomotive, does not by any means prove that it is superior for every-day operation. The relative economy of the different types depends also on the first cost, the cost of maintenance, the maximum sustained power output and the yearly mileage that can be obtained.

Whatever the outcome of the tests of these radical locomotive designs may be, they will probably lead to the development of equipment that will be useful for certain classes of service, although the reciprocating steam locomotive will no doubt hold its place for some time to come. It is to be

hoped that at least one of the new locomotives will be a success, for this would spur all who are interested in the present type of locomotive to increased efforts. Recent years have been notable for the lack of initiative in departing from established methods and something seems to be needed as a spur to further development.

An array of figures, no matter how well tabulated, can never be compared for ease and quickness in grasping changing

#### Diagrams for Keeping Control of Operations

conditions with the same figures converted into a diagram. It does not require an engineering training or any special knowledge to appreciate the meaning of an upward or downward trend of a line with a suitable scale at the side. Such diagrams were originally used by engineers but their value was so apparent and their field of application so wide and varied that they are now commonly used in all kinds of activities by business men, manufacturers, purchasing agents, storekeepers, etc. With a little ingenuity diagrams can be so laid out in such simple form that they can be filled in by any clerk. Thus far their use does not appear to be nearly as common in the railroad field as in many others, although their value is fully as great to a railroad man as to any other. By systematically plotting the figures from periodical reports, daily, weekly, or monthly, as the case may be, one can instantly see the trend and control matters accordingly. Thus the number of men employed, the number of engines turned per day, the length of time required for overhauling an engine or passenger car, the output of machines, the coal consumed by stationary boilers, are but a few examples of the places where the use of diagrams have proved helpful. To the storekeepers they are invaluable. As an illustration, 4 in. by 6 in., or any other standard size cards may have twelve vertical lines, one for each month, and a suitable scale selected by which the stock on hand the first of each month may be marked. A glance at such cards will tell at once whether the stock is sufficient. Many storekeepers and purchasers also find it important to keep similar cards showing stock drawn as an aid in placing requisitions or in making contracts for purchases. One of the best proofs of the value of diagrams is indicated by the fact that practically every one who has started to use them for one or two things has soon found other places where they may be applied to advantage. If you have not used them, why not take some particular case and see how much more of a story a diagram will tell you than a tabulation of figures?

One of the first things which will occur to any "live-wire" industrial manufacturer, visiting the average railroad shop,

#### Why Continue to Use Obsolete Machinery?

is the number of old and obviously inefficient machine tools used. In most cases the shop foreman or master mechanic will say that appropriations for new machines cannot be secured, or if they are secured, the purchasing agent buys the cheapest machine available of the type needed. The result is that old machine tools cannot be replaced and often new machines purchased are of a type inferior to the particular ones requested. Such conditions exist largely because higher railroad executive officers, including the presidents, do not know exactly what the conditions are and fail to realize the needs. Maintenance of equipment is but one part and possibly a minor one of the many problems confronting these officers. They cannot appreciate the losses due to inadequate shop equipment unless these are forcefully demonstrated.

It is the duty of shop and mechanical department officers to show in an unmistakable way just what the annual loss is from operating inefficient shop machines. The higher railroad officers should be made to appreciate that large amounts of money are saved or lost depending on the condi-

tion of shop equipment and machinery. As an example of the failure of mechanical department men to get across with their story of shop needs, a specific case may be mentioned. A turret lathe manufacturer, socially acquainted with the president of a large railway system, had been trying to introduce his machines on the system. In four or five shops he tried and failed, the road having purchased additional old-style, cheaper and less efficient machines. The question was brought up at another shop and the mechanical officer in charge again recommended this machine but said that it was hopeless to secure approval from the management on account of its cost. In leaving the office, the manufacturer encountered the president of the railroad and during a brief chat, explained the purpose of his visit. The president asked the mechanical officer if he believed claims regarding the machine were accurate and was told that they were. He then stated that he would approve the purchase. A few months after the machine was installed, the president of the railroad again met the manufacturer and became quite enthusiastic about his machines saying that he had personally observed them doing about five times the work of the old machines. He then asked why these machines were not installed before and was told that for 10 years every requisition for them had been turned down in spite of the best efforts of the manufacturer with both the mechanical and purchasing departments.

If there is one duty more than another which is strictly up to the shop and mechanical department officers, it is to wake up and find out exactly how much their roads are losing every day by the operation of inefficient machinery and shop equipment fit only for the scrap pile. If accurate figures are compiled showing the cost by present methods and the savings possible with modern equipment, the figures will be sufficiently large to attract the attention of even the highest railroad officers to whom they are presented. As soon as the real need of the shops is appreciated by higher railroad officers, there will be far less difficulty in getting the required appropriations for new tools.

When the idea of the steel car was first advanced there was a general feeling that such cars would eventually replace all

#### Mill Room Equipment Important

wooden equipment and last practically forever. This supposition has since been shown to be without basis in fact since steel cars do eventually deteriorate, and with great speed, especially in some kinds of service. In freight car equipment there has been a noticeable reaction in favor of the wooden, or at least of the composite car, and while the old fashioned railroad mill room may have lost forever its position of first importance in car repair work it is still a vital factor. Many men fail to appreciate the immense quantity of lumber worked up annually in railroad mill rooms and the consequent need of an adequate amount of modern, labor-saving, mill room machinery. A single large eastern railroad, for example, uses 100,000,000 board feet of lumber annually for bridge timbers, car sills, framing, flooring, roofing, siding, lining, etc., exclusive of ties. When it is remembered that there are about 200 Class I roads in the United States some of which use less but others probably more lumber than the road quoted, some conception can be had of the enormous total consumption of lumber. This lumber must all be machined to size and finished in accordance with the service expected of it and the railroads cannot afford to do this work with anything less than the best of modern wood-working machinery.

Not only should an adequate amount of modern machinery be installed but every effort should be made to keep present machines in the best of repair and working condition. In addition, it is essential to provide means for properly sharpening machine knives, cutters, saws and other tools. A sharp tool will do its work far better than a dull one; also more

quickly and easily; in the majority of cases the best way to keep tools sharp is by means of automatic machinery developed for the purpose. While it is possible to sharpen a circular saw, for example, by hand the result is relatively unsatisfactory. It is impossible to get the same degree of regularity with hand filing as with an automatic machine and regularity is needed. To cut efficiently a circular saw must be accurately round with uniform teeth and with a gullet outline affording the proper hook for the wood being sawed. The term "wood-butchers" is aptly applied to those so-called practical men who cannot afford the time to keep their saws and cutting tools sharp. In consideration of the immense amount and value of the lumber that is cut and dressed and the power and labor expended the importance of sharp cutting tools and an adequate amount of modern mill room machinery is evident.

### Grinding Car Journals

FOR some time the *Railway Mechanical Engineer* has taken the stand that grinding machinery and methods are not utilized as extensively in American railway shops as they should be. Among other uses, the grinding of locomotive and car axles presents an extensive field in which there is reason to believe that the grinding machine can affect great aggregate savings. According to one of our English contemporaries, railway shop managements in England have already taken active steps looking towards this use of grinding machines, as a result of tests of axles roughed out on axle lathes and finished at both the journals and wheel seats by grinding.

It is felt in England that the accuracy of machining railway equipment axles is second only in importance to the quality of the metal, and the machinist as well as the metallurgist can do much to increase the service secured from axles. In the tests referred to, axles were roughed out in accordance with previous practice on production axle lathes, but instead of being finish turned and rolled, both the journal and wheel seats were finished by grinding. The production times for the various operations were recorded. For example, one of the heaviest English axles, having a  $5\frac{5}{8}$  in. by  $10\frac{3}{8}$  in. journal with a  $7\frac{3}{4}$  in. by  $8\frac{1}{16}$  in. wheel seat was roughed out on the journals and wheel seats in an axle lathe in 13 minutes. The axle was turned to within  $1/16$  in. of the finished size, using a feed of approximately  $1/16$  in. per revolution and without using any measuring device except the stops on the machine. This axle was then placed in the grinding machine and finished in 45 min. Admitting that 13 min. for rough turning and 45 min. for finish grinding were obtained under favorable test conditions, an increase of 25 per cent could be allowed to cover the contingencies occurring throughout the normal working time and still leave an attractive time-saving in favor of grinding as against turning and rolling for the axle finishing operation.

In addition to taking less time for the operation, grinding presents a more accurate method of finishing journals. The journals could be ground to within less than .001 in. of being perfectly round and straight with a marked improvement in the quality of the journal as regards weight carrying capacity. The above tests demonstrated the fallacy of the old argument that rolling provides a better method of finishing journals due to the surface of the metal being compressed and hardened. To quote from test data, "axles ground leaving a diameter .005 in. above size were rolled but no diminution of diameter was found and the surface was not improved. The axles were then reground to plus .0005 in. and gain rolled, the reduction in diameter being small and uneven. In some cases there was no reduction at all showing that the rollers only had an effect where a soft spot in the metal was encountered. The only result was

to render the axle out of round." Hardness tests showed that ground axles are fully equal in this respect to rolled axles. A file will take hold with equal or less pressure on the rolled axle.

Not only should the journals be ground, but according to the tests it was a paying proposition to finish the wheel seats by grinding. The wheel-mounting pressure gage gives an indication of the quality of the fit and obviously there is a far greater chance of seizing in the case of turned fits than with the smoother ground fits. The small irregularities or tool marks in the wheel fit greatly increase the force required to apply the wheel. Once these irregularities are smoothed out, however, the wheel comes off easily and with less than the recommended mounting pressure. In the case of a ground fit, the surfaces are smooth with a long even bearing, enabling a uniform mounting pressure to be maintained. This pressure is not required to smooth off the rough places, but represents a true force fit. Railroad shops in this country have already introduced grinding machines for finishing the journal and wheel seats of driving axles and to a less extent car axles. In view of the decreased time required for the operation and the relatively better work, this practice should be more generally extended.

### NEW BOOKS

INDEX-DIGEST OF DECISIONS OF UNITED STATES LABOR BOARD. 322 pages, 6 in. by 9 in. Published by the Railway Accounting Officers' Association, 1116 Woodward building, Washington, D. C.

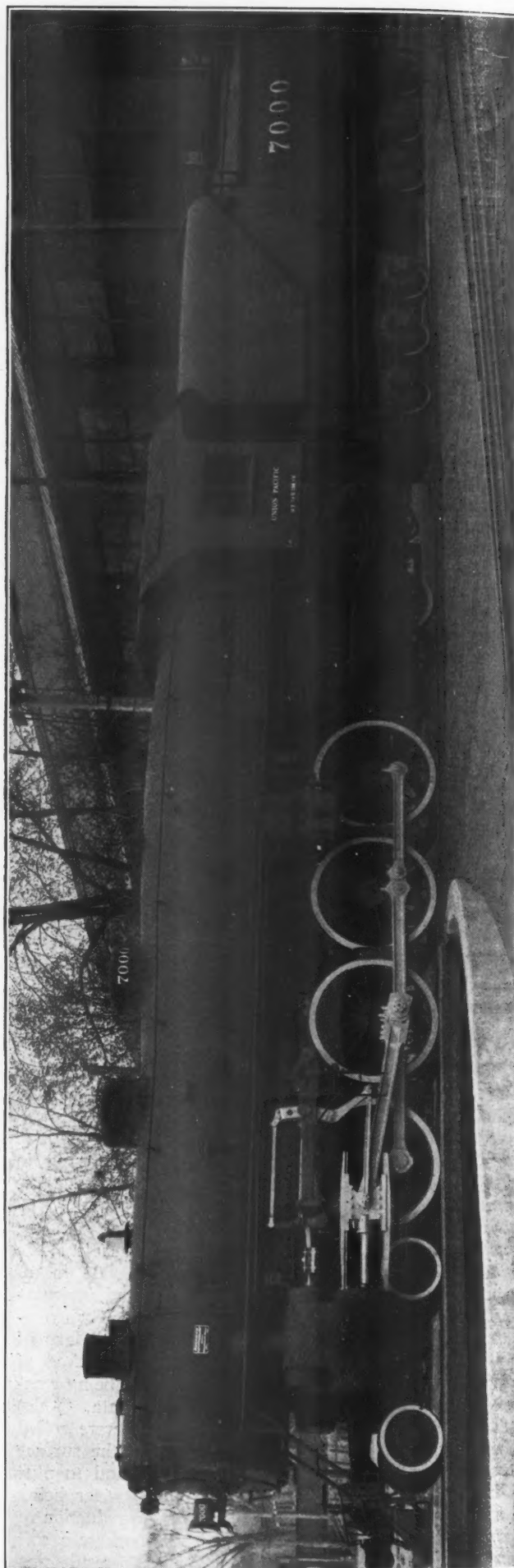
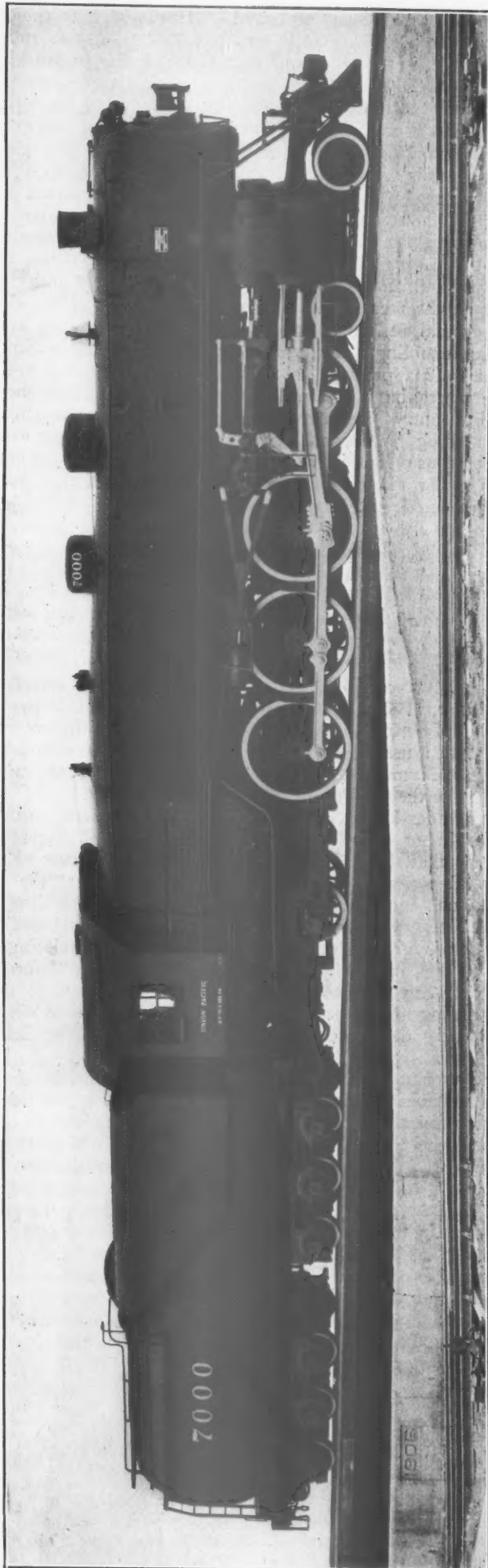
This is the second edition of a publication first issued in September, 1921. The decisions were compiled by the Bureau of Information of the Southeastern Railways and proved very useful to railroad officers who deal with labor matters. Numerous requests for bringing the book up to date led to the publication of the present volume.

This Index-Digest gives the gist of every decision rendered by the Labor Board up to May 1, 1922. References are given so that the full text may be obtained whenever necessary. Experience has demonstrated, however, that the use of the book eliminates the time and labor of reading through the full text of the decisions. Under alphabetical subject headings is given a summary of every decision relating to each subject, containing all the necessary practical information that anyone would ordinarily have occasion to use. This arrangement is so convenient as to enable one to obtain readily any desired data regarding decisions of the Labor Board.

The present edition has the added feature of setting forth each decision rendered in connection with the individual labor organizations, similar information being given in connection with each railroad. These two additions prove especially useful in cases where the particular decision or principle involved is remembered by the labor organization or by the name of the railroad. The publication is indexed and cross-indexed in almost every conceivable way.

The book should prove indispensable to foremen, shop accountants, time keepers and all others who must be well informed regarding the decisions rendered by the Railroad Labor Board. Individual copies of the book are sold by the association for a nominal sum and the price is still further reduced when ordered in large quantities.

The Bureau of Mines has undertaken, at the Pittsburgh experiment station, an investigation of the mechanism of scale formation in steam boilers. The object of the investigation is to determine if the character of the precipitates forming in boilers may be made to assume a form in which they do not attach themselves to the walls, and also to ascertain if the material in the boiler wall exercises any influence.



Union Pacific Mountain Type Locomotive for Heavy Passenger Service

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# A Mountain Type Locomotive for High Capacity

New Union Pacific Locomotive Is Lightest  
Per Unit of Power of Any 4-8-2 Yet Built

THE first Mountain type locomotive to be employed on its line was recently delivered to the Union Pacific by the American Locomotive Company. This locomotive is the lightest in proportion to maximum horsepower capacity, of any locomotive of this type which has yet been built and the design is the result of an unusually painstaking study both by the railroad staff and by the builders.

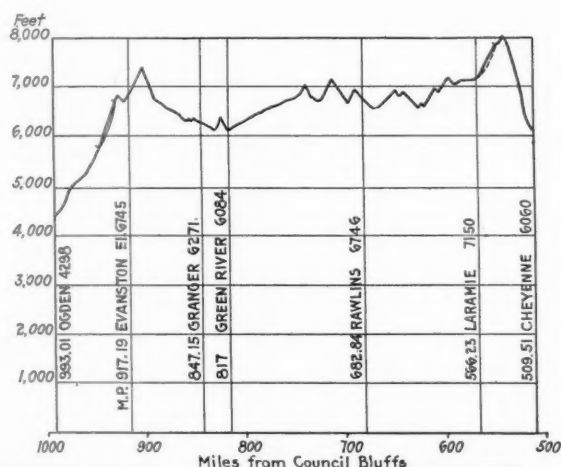
The locomotive has a total weight of 345,000 lb. of which 230,000 lb. is on the drivers. It has a maximum tractive effort of 54,800 lb., and, using Cole's ratios as a basis of comparison, has a maximum horsepower capacity of 3,030

Rawlins to Green River and from 30.9 to 36.4 miles an hour from Green River to Evanston. Eastbound the schedules call for average speeds of from 33.4 to 36.1 miles an hour between Evanston and Green River, 34.3 to 36.6 miles an hour from Green River to Rawlins and 35 to 37 miles an hour from Rawlins to Laramie. Few stops are called for on any of the overland trains except at division points.

To maintain these schedules with Mikado type locomotives it has been necessary to resort to high running speeds on the down grades to make up for the comparatively low speeds on the heavy up-hill pulls. This has had a marked effect in increasing track maintenance and to some extent the cost of locomotive maintenance. The Mountain type locomotive with its high sustained capacity is expected to bring the maximum and minimum operating speeds more nearly to the average which, in addition to its effect on maintenance costs will produce more economical locomotive operation and facilitate the operation of the road generally.

The design of a locomotive of this type was first considered in the fall of 1920. During the preliminary stages many valuable suggestions were received both from the Baldwin Locomotive Works and the Lima Locomotive Works, Inc., as well as from the American Locomotive Company. The final design, however, was worked out practically complete in detail by the railroad's own staff.

In general the boiler is similar in capacity and dimensions to the boiler of the Union Pacific 2-10-2 type locomotive. It is conical in form with an outside diameter of 84 in. at

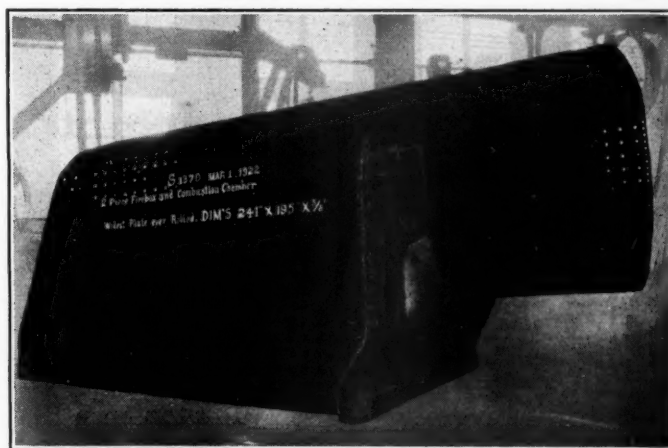


Profile of the Line Over Which the New Mountain Type Locomotive Will Operate

with a 98.5 per cent boiler and a grate area about 4 per cent greater than that called for by Cole's ratios, in proportion to the evaporative capacity. The locomotives will burn a semi-bituminous coal, low in ash but high in moisture, which has a heat value of about 12,000 B.T.U. per lb. In point of weight per unit of capacity the new locomotive compares very favorably with No. 50000, the American Locomotive Company experimental Pacific type. This engine established a record of 110.8 lb. total weight of locomotive in working order per cylinder horsepower, by Cole's method of calculation. The new Union Pacific locomotive weighs 113.9 lb. per cylinder horsepower and 115.8 lb. per boiler horsepower. The No. 50000, with a 92 per cent boiler, weighs 120.5 lb. per boiler horsepower.

The new Mountain type locomotive is intended primarily for use in passenger service between Cheyenne, Wyo., and Ogden, Utah, a distance of 484 miles over which, because of the long and frequent grades encountered, passenger trains are now handled by Mikado type locomotives. The character of the line is shown in the accompanying profile. With trains varying from 8 to 13 cars the time card calls for schedules averaging from 28 to 31 miles an hour between Cheyenne and Laramie and from 26 to 32½ miles per hour between Evanston and Ogden.

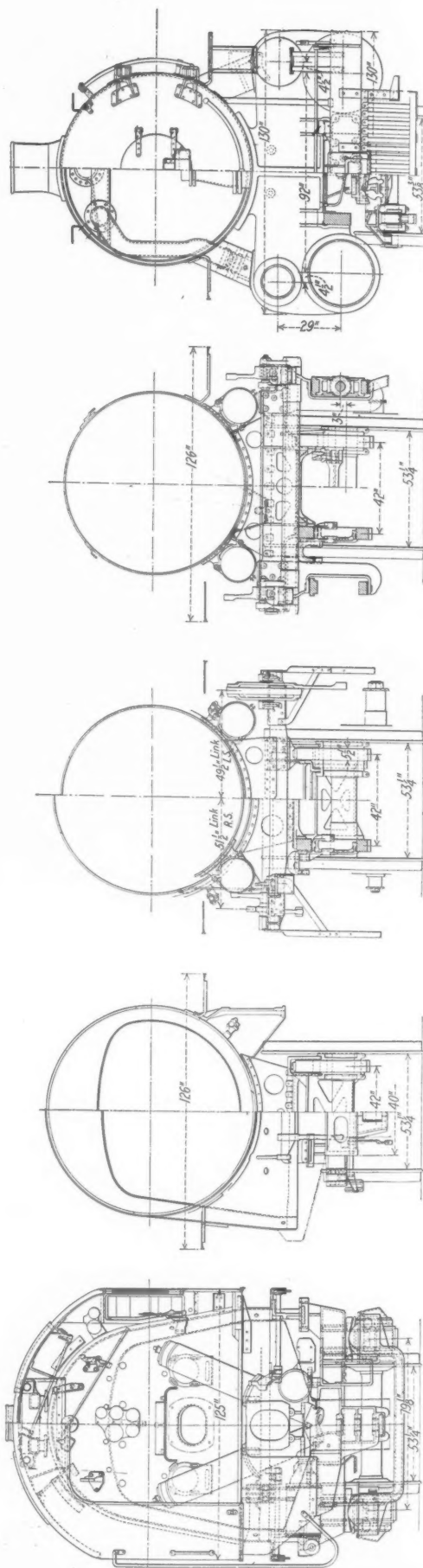
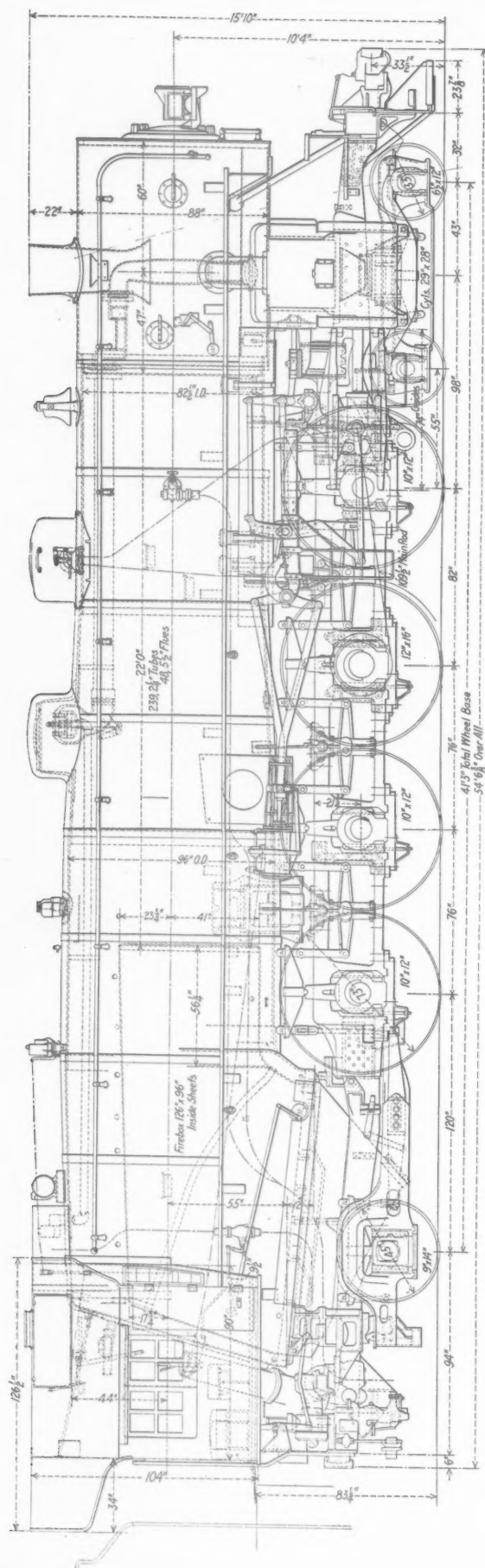
Although the net difference in elevation between Laramie and Evanston is not as great as on either of the above named districts, the grades are long and numerous. Westbound the schedules vary from 33.3 to 43.7 miles an hour between Laramie and Rawlins, from 35 to 42.4 miles an hour from



The Firebox Side Sheets and Crown Sheet and Combustion Chamber Are All in One Piece, the Throat Sheet Being Welded in as Shown by the Light Line

the front barrel course, increasing to 96 in. at the combustion chamber course. The firebox measures 126 in. by 96 in. at the grate and includes a combustion chamber the length of which is such as to provide for tubes 22 ft. long. One of the notable features in the design of the boiler is the location of the steam dome on the conical course at a point above the center of oscillation of the water in the boiler. This provides a uniform steam space under all conditions of grade, considerably removed from the zone of violent ebullition over the crown sheet. The firebox is fed by a Duplex stoker and the boiler is fitted with a 48-unit superheater.

The boiler shell courses are of ¾-in., 13/16-in. and 7/8-in.



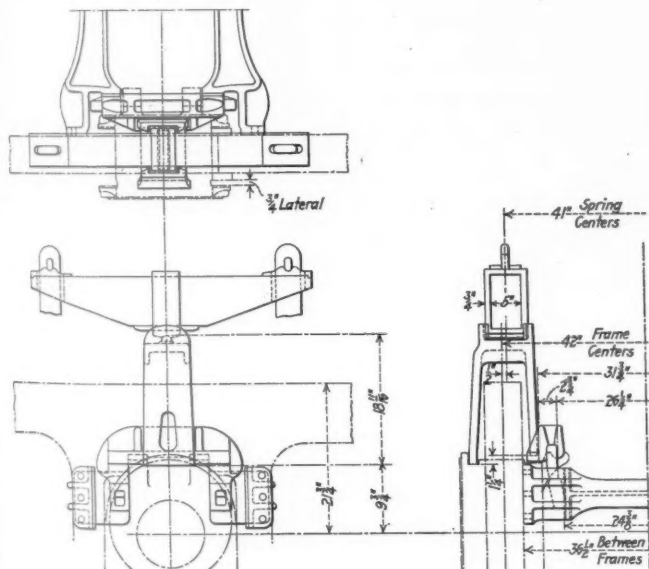
### Elevation and Cross-Sections of the Union Pacific Mountain Type Locomotive

material, respectively, and the wrapper sheet is 9/16 in. thick. The firebox crown, sides and the combustion chamber are of 3/8-in. sheets, with a 1/2-in. throat connection sheet welded in between the side sheets and the combustion chamber. The form of this sheet is shown in one of the photographs. The firebox is fitted with F.B.C. welded staybolt sleeves and bolts of reduced body diameter.

Steam distribution is controlled by the Young valve gear, and the Alco power reverse gear. The Young valve motion provides a maximum travel of 9 in. and drives a 14-in. piston valve. The locomotive is also equipped with a Fetters automatic drifting valve. This device insures the constant admission of a small supply of saturated steam to the cylinders as long as the locomotive is in motion with the throttle closed. The admission of saturated steam is controlled by a diaphragm operated valve, one side of the diaphragm being loaded at a pressure of 40 lb. per sq. in. by a small oil pump driven from the valve motion link trunnion, and the other acted on by the dry pipe pressure. Either the opening of the throttle or the stopping of the engine cuts off the saturated steam supply, thus making the device entirely automatic.

The frames are of straightforward, rugged design, in general following the practice of the builders as to the dimensions of the sections. Between the cylinder saddle and the front pedestal the frame takes the form of a deep slab section. This, however, has been lightened by coring out the middle portion of the slab for a part of the thickness on the outside, the reduction in the mass of metal at this point being of considerable advantage in the foundry. The binders of the main pedestal are fitted with three bolts, and

genious bell crank arrangement, the trunnions of which are carried on lugs projecting from the top of the box inside the frames. The horizontal arm of this bell crank extends laterally across the top of the box and forms the seat for the inside leg of the spring saddle. Normally, it rests on the top of the box. The vertical arm of the bell crank is carried down on either side of the axle, lugs on the lower ends fitting in recesses between the inside face of the frame and flanges on the cross braces bolted to the pedestal faces. The clearance in these recesses permits the movement of the box outward without operating the bell crank. Inward movement of the box, however, causes the engagement of the lugs



New Design of Woodard Lateral Motion Driving Box

heavy toes have been provided on the front and main jaws.

A notable feature of the frame construction is the location of the furnace bearer-supports directly under the sides of the mudring, these supports forming a part of the cradle casting. The furnace bearers are fitted with compression grease cups.

Several features of the running gear are of particular interest. The forward pair of drivers are fitted with the Franklin lateral motion device, which has recently been redesigned to effect a material saving in weight. The forward driving boxes are not joined together, as was the case in the former design, each being provided with a limited lateral movement by spreading the shoe and wedge flanges of the boxes to provide clearance both inside and outside the frame jaw. When not operating under lateral thrust each box is retained in a normal central position by means of an in-



A Front View of the Locomotive

on the bell crank arm against the flanges of the cross braces and results in raising the horizontal arm of the bell crank up from the top of the box. This tilts the spring saddle and creates a load which, acting through the bell crank, resists the lateral displacement of the box. This device is shown in one of the drawings.

The main driving journals are fitted with long driving boxes, the design of which provides for the use of a spring saddle, rather than seating the spring directly on the cross equalizer. Instead of delivering the load at a single point at the center of the box this design permits the load to be applied equally at the two ends of the long main box the same as in the cases of boxes of the usual type located symmetrically with respect to the center line of the frame. Driving boxes are fitted with Franklin automatic wedges.

The engine truck is of the Woodard constant resistance type and Woodard constant resistance rollers have been incorporated in the design of the trailer truck.

The side rods are fitted with spherical bushings on the front crank pins and a floating bushing has been applied at the main crank pin connections. Annealed carbon-vanadium steel has been used in the side and main rods, piston rods, driving and trailing truck axles and in the main crank pins. The piston heads are of Z-section cast steel, faced with phosphor bronze poured in place. The cylinder

and valve bushings, the cross head shoes and piston rings are of Hunt-Spiller gun iron.

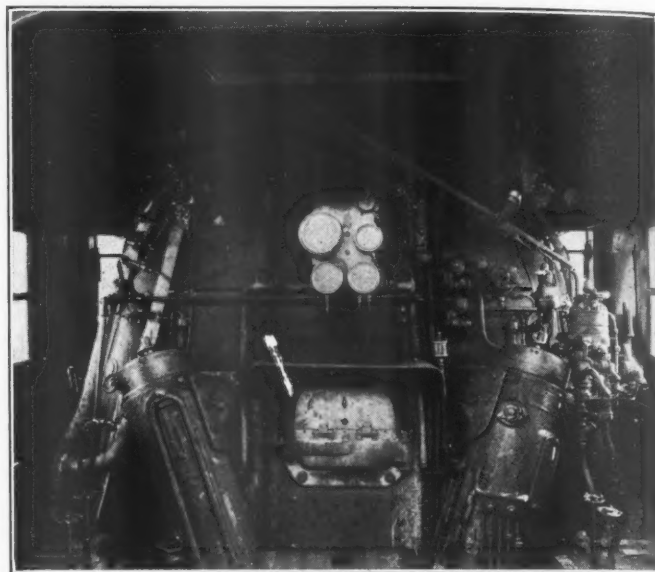
The following table shows the weights of the reciprocating parts:

Piston rod (hollow).....	334 lb.
Piston head.....	505 lb.
Packing rings.....	100 lb.
<hr/>	
Total weight of piston complete.....	939 lb.
Main rod, complete.....	864 lb.
Crosshead, with shoes.....	640 lb.

At a speed of 60 miles an hour this locomotive produces a dynamic augment of 27 per cent. At a speed of 73 miles an hour, which is equal to the diameter of the drivers, the dynamic augment is 39 per cent.

One of the notable features in the design of this locomotive is the care which has been exercised in locating the cab fittings and the piping, and in securing rigidity in the attachment of air drums, piping and other apparatus commonly secured to the running board. All the apparatus on the back boiler head and all piping on the locomotive was carefully located in the drawing room. One of the photographs shows the resulting neat and uncrowded appearance of the back head. It will be noted that the operating handles of the valves controlling the admission of steam from the turret to the auxiliaries have been carried out by means of flexible shafts to a location at a convenient height above the head of a person standing on the cab deck, where they are all supported in a horizontal rack, each one identified by a suitable label. All outside piping has been located under the running board, as little in evidence as possible, an ar-

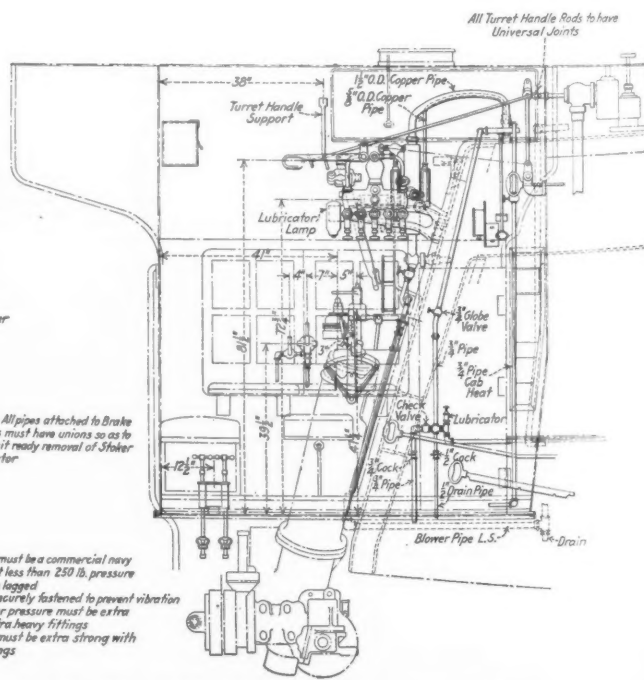
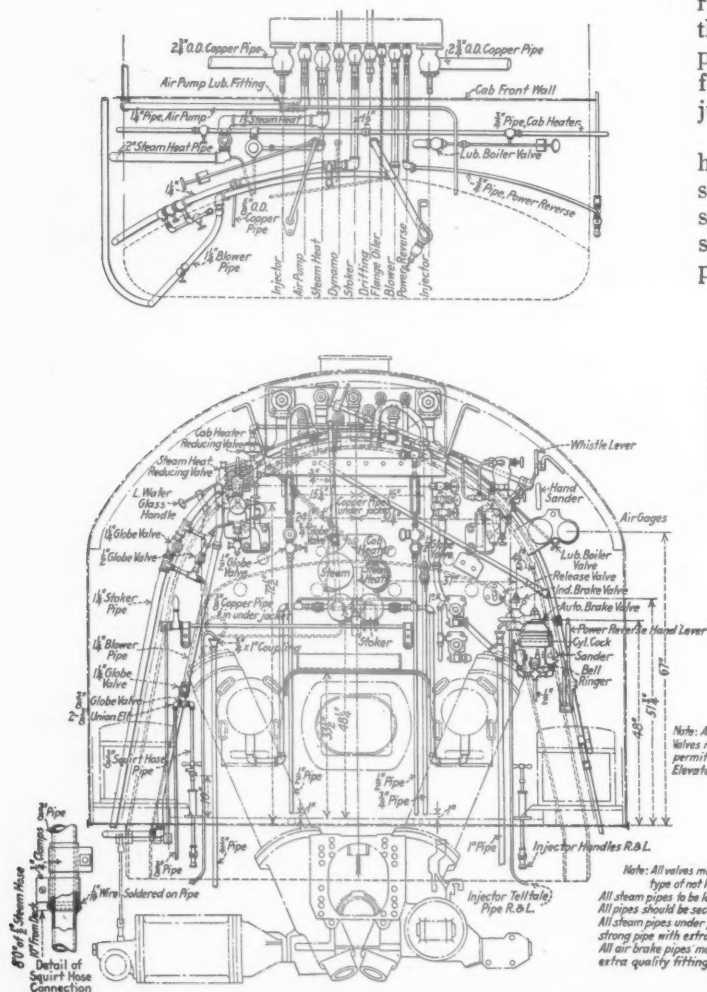
angement which not only improves the appearance of the locomotive but offers an opportunity for the employment of effective clamps, subjected to the minimum of vibration. The main reservoirs are located well down under the barrel of the boiler, to which they are securely attached. The distributing valve, instead of being attached to the running



The Fittings Inside the Cab Are Unusually Well Arranged

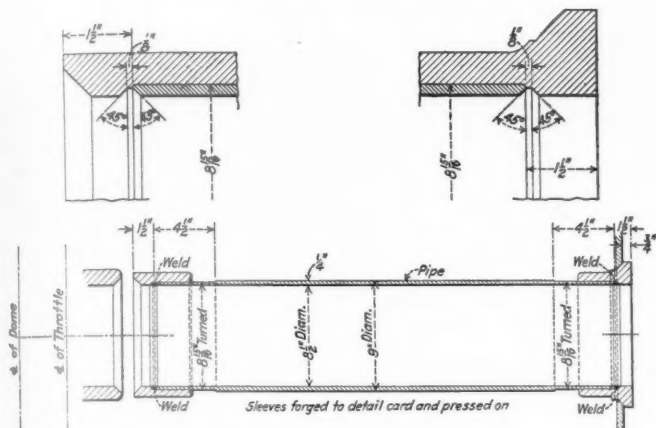
board where it is subjected to considerable vibration, is carried on a heavy plate bracket which is secured directly to the cradle casting. The driver brake cylinders are bolted to pads which are cast integral with the main frames, each forming in effect an extension of the inside face of the frame just back of the cylinder casting.

Each side of the cab in front of the window opening is hinged at the front and may be opened outward to facilitate staybolt work or other jobs requiring access to the narrow space at the sides of the boiler. When the locomotive is in service and the doors do not need to be opened they are permanently closed with bolts.



All Cab Fixtures Were Located and Piping Laid Out on the Board Before the Locomotive Was Built

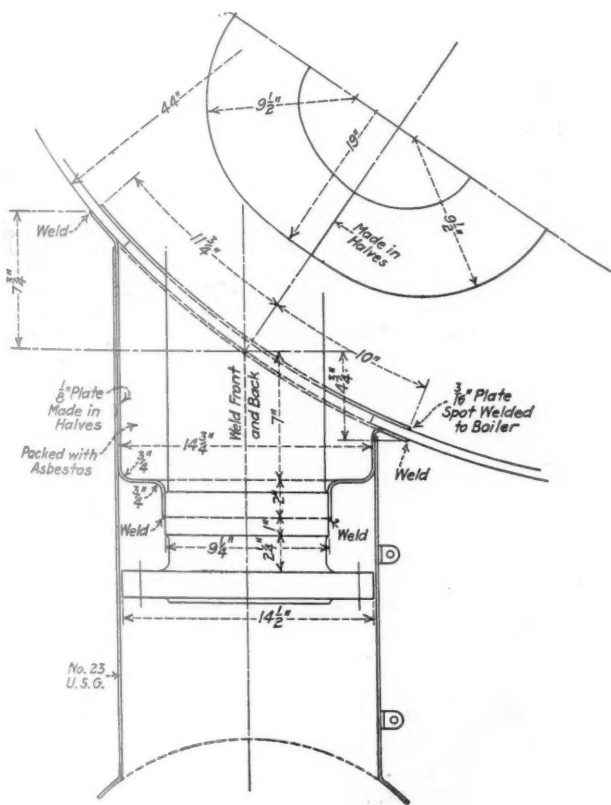
The tender is of the Vanderbilt type with a water capacity of 12,000 gal. and a coal capacity of 20 tons. The tank is carried on a Commonwealth cast steel underframe. The



Method of Welding the Dry Pipe

transverse members of the underframe, which form the tank saddles, are cored out to receive thin filler blocks of wood which are accurately surfaced to conform to the contour of the tank.

The tank is secured to the underframe by cast steel brackets of angle section the vertical flanges of which are bolted to the cross members of the underframe. The tender is carried on Commonwealth six-wheel trucks with



Arrangement of Outside Steam Pipe Casing Gland

6-in. by 11-in. journals and 33 in. wrought steel wheels. The engine and tender are connected by Unit safety draw bars and are fitted with Radial buffers.

Among the specialties with which the locomotive is equipped are Pyle-National headlight equipment, Nathan non-lifting injectors and lubricator, Paxton-Mitchell piston and valve rod packing, and Okadee blow-off valve, feed water strainers, cylinder cocks and smokebox hinges. The locomotive

is also equipped with a Madison-Kipp force feed lubricator.

The principal dimensions and data of the locomotive are as follows:

#### DIMENSIONS, WEIGHTS AND PROPORTIONS

Service .....	Passenger
Cylinders, diameter and stroke.....	29 in. by 28 in.
Valve gear .....	Young
Valves, kind and size.....	Piston—14 in.
Maximum travel .....	.9 in.
Outside lap .....	1 1/4 in.
Exhaust clearance .....	1/8 in.
Lead in full gear .....	1/4 in.
Cut-off in full gear .....	.90 per cent

#### Weights in working order:

On drivers .....	230,000 lb.
On front truck .....	59,000 lb.
On trailing truck .....	56,000 lb.
Total engine .....	345,000 lb.
Tender .....	237,800 lb.

#### Wheel base:

Driving .....	19 ft. 6 in.
Rigid .....	12 ft. 8 in.
Total engine .....	41 ft. 3 in.
Total engine and tender .....	79 ft. 11 1/2 in.

#### Wheels, diameter outside tires:

Driving .....	73 in.
Front truck .....	33 in.
Trailing truck .....	45 in.

#### Journals, diameter and length:

Driving, main .....	12 in. by 16 in.
Driving, others .....	10 in. by 12 in.
Front truck .....	6 1/2 in. by 12 in.
Trailing truck .....	9 in. by 14 in.

#### Boiler:

Type .....	Conical
Steam pressure .....	200 lb.
Fuel, kind .....	Semi-bitum., 12,000 B.t.u.
Diameter, first ring, outside.....	84 in.
Firebox, length and width.....	126 in. by 96 in.
Height, grate to crown sheet, back.....	72 in.
Height, grate to crown sheet, front.....	84 in.
Arch tubes, number and diameter.....	4—3 1/2 in.
Combustion chamber, length.....	56 1/4 in.
Tubes, number and diameter.....	239—2 1/4 in.
Flues, number and diameter.....	48—5 1/2 in.
Tubes and flues, length.....	22 ft.
Grate area .....	84 sq. ft.

#### Heating surfaces:

Firebox, incl. comb. chamber and arch tubes.....	382 sq. ft.
Tubes .....	3,084 sq. ft.
Flues .....	1,508 sq. ft.
Total evaporative .....	4,974 sq. ft.
Superheating .....	1,242 sq. ft.
Comb. evaporative and superheating.....	6,216 sq. ft.

#### Tender:

Style .....	Cylindrical tank
Water capacity .....	12,000 gal.
Coal capacity .....	20 tons
Trucks .....	6-wheel
Truck wheels .....	33-in. steel
Truck journals .....	6 in. by 11 in.

#### General data, estimated:

Rated tractive force, 85 per cent.....	54,838 lb.
Cylinder horsepower .....	3,030 hp.
Boiler horsepower .....	2,980 hp.
Speed at 1,000 ft. piston speed.....	46.5 m.p.h.
Steam required per hour.....	6,300 lb.
Boiler, evaporative capacity per hour.....	6,200 lb.
Coal required per hour, total.....	9,843 lb.
Coal, rate per sq. ft. grate per hour.....	117 lb.

#### Weight proportions:

Weight on drivers ÷ tractive force.....	4.19 lb.
Weight on drivers ÷ total weight engine.....	66.7 per cent
Total weight engine ÷ cylinder horsepower.....	113.9 lb.
Total weight engine ÷ boiler horsepower.....	115.8 lb.

#### Boiler proportions:

Boiler horsepower ÷ cylinder horsepower.....	98.5 per cent
Comb. heating surface ÷ cylinder horsepower.....	2.05
Tractive force ÷ comb. heating surface.....	8.82
Tractive force × dia. drivers ÷ comb. heating surface.....	.644
Cylinder horsepower ÷ grate area.....	36.1
Firebox heating surface ÷ grate area.....	4.55
Firebox heating surface ÷ evap. heating surface.....	7.7 per cent
Superheating surface ÷ evap. heating surface.....	25.0 per cent

# Turbine Locomotive Saves 52 Per Cent in Fuel

Design Brought Out by Ljungstrom Turbine  
Company of Sweden Has Many Novel Features

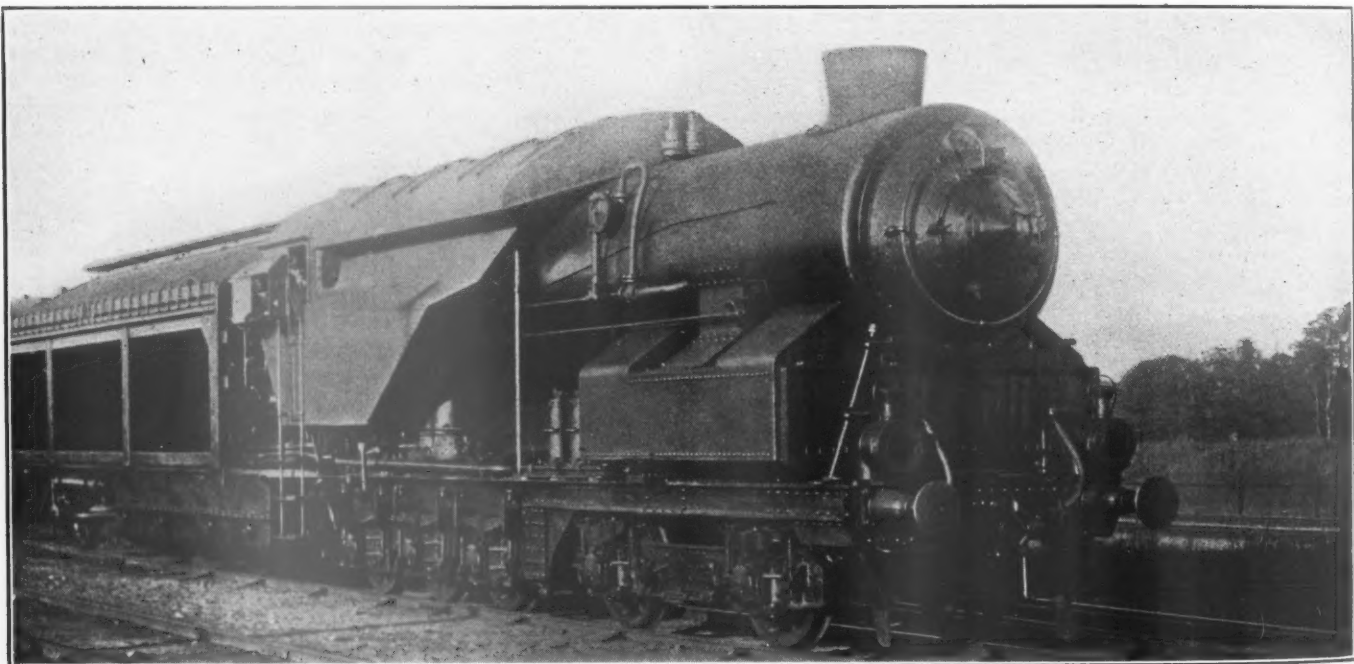
A CONDENSING turbine locomotive, designed by F. Ljungstrom and constructed by Aktiebolaget Ljungströms Angturbin, Stockholm, Sweden, was placed in service on the Swedish State Railways a few months ago. According to reports, the locomotive has performed satisfactorily and has shown remarkable economy in fuel. Complete details of the construction are not yet available but the photograph shown herewith indicates that it is a radical departure from conventional locomotive design in appearance as well as in mechanical construction.

The turbo-locomotive designed by Mr. Ljungstrom is intended to displace the Pacific type locomotives now used in passenger service on the Swedish State Railways. It is not a mere adaptation of the turbine to reciprocating locomotives, but is a new design in all respects. Unlike ordinary steam locomotives, there is no driving machinery under the boiler.

sary cold air entering the firebox flues. The exhaust steam is not discharged from the stack but is led to a condenser on the tender.

The driving machinery consists of a high-speed turbine suitably geared to the six-wheel connected running gear which has drivers 58 in. in diameter and is located under the tender. The condensing tank has a capacity of 3,650 gallons but only half of that amount has been carried on the trial trips and has been found sufficient as the exhaust steam is not wasted through the stack but returns to a hot well from which it is pumped into the boiler as feedwater. As the feedwater is used over and over, very little scale will be formed in the boiler. The preheating of the air for combustion should also add to the life of the firebox and materially reduce the expense of boiler work.

The locomotive is being used in passenger service out of



Turbine Locomotive on the Swedish State Railways

Instead it is supported by two trucks, the forward with two and the rear with three axles. The driving machinery is located under the tender unit, which also contains the condenser and the necessary fans for aiding in condensation. The coal supply is carried in bunkers placed above and on each side of the cab, having a capacity of seven tons. The boiler is of the ordinary fire-tube type, carrying 285 lb. pressure. It has no small tubes, the heating surface in the barrel of the boiler being made up of large flues, each of which carries a superheater element, thus giving a high degree of superheat.

Another innovation is the arrangement for heating the air supplied to the fire. The space between the mud ring and the ashpan is tightly closed and the air needed for combustion passes through a special air preheater under the smokebox, where the temperature is raised by escaping gases from the smokebox. Draft is created by a fan propelled by a small turbine. A damper connected with the firebox door shuts off the draft when the door is open, thus preventing unneces-

Stockholm on turn-around trips of 66 kilometers, or about 41 miles, each way. The time between the departure from Stockholm and the return is 2 hrs. 30 min. As no information is given as to the time at the turn-around point or the length of the stops en route, no estimate can be made as to the speed while on the road.

On a local run on this route with a passenger train weighing 603 tons, the coal consumption was 20.8 kilograms (45.8 lb.) per 1,000 ton kilometers, or about 67 lb. per 1,000 gross ton-miles. In through service the consumption was reduced to about 11.6 kilograms (25.6 lb.) per 1,000 ton kilometers, or 37.4 lb. per 1,000 gross ton-miles. Considering that this performance was obtained during the winter season the figures are indeed remarkable. Compared with the reciprocating superheated Pacific type locomotives used on the same run, the turbine locomotive shows a reduction of 52 per cent in the consumption of fuel. Further details of the locomotive construction and the results obtained in service will be published in a later issue.

# Fuel Association Holds Annual Meeting

## Heavy Program Includes the Consideration of Many Operating Problems Affecting Fuel Economy

EVIDENCES of the interest in and support of the railway fuel conservation movement on the part of executives and operating officers and an interest in the relation of fuel costs to other operating factors characterized the fourteenth annual convention of the International Railway Fuel Association, which was held at the Auditorium

Hotel, Chicago, on May 22 to 25 inclusive. After the usual opening exercises the meeting, with over 450 members in attendance, was addressed by L. W. Baldwin, vice-president, Illinois Central, followed by the address of W. L. Robinson (B. & O.), president of the association. Mr. Baldwin spoke in part as follows:

### L. W. Baldwin's Address

THE conservation of fuel rests largely with these two principles: 1. Interesting and educating the men who place fuel on the fires, and 2. Developing and using proper machinery. My experience has taught me that each of these constitutes a vast field of opportunity.

Coal means more now than it did prior to the war. The increased cost has made it necessary for us to get our coal burned in such a way as to use a minimum amount and get maximum efficiency. On the railroad of which I am an officer we maintain an organization to educate our men to burn coal scientifically. This organization has a car fitted up for holding fuel conservation classes and is constantly visiting the terminals, large and small alike. The men doing this educational work are peculiarly fitted for their duties. They have studied fuel production and uses from various angles, and they impart their experience to the men, display films, make replies to questions, and exchange views on all phases of fuel conservation in their meetings, in fact so impress officers and men that they actually appreciate it is a crime to waste fuel.

The education of the men and the carrying out of good practices cover a wide scope of endeavor on the part of those in charge of and who are to teach fuel conservation. Great care must be taken to insure the selection of men for such positions who are qualified by experience, are natural enthusiasts and in whom all who should be concerned in fuel economy have confidence.

We have distributed a book entitled "Fuel Economy on Locomotives" which deals with the subject at length, but we can't depend on the book to do the work. To get the best results, it is necessary to employ the personal contact method.

In addition, we have a General Fuel Conservation Committee, consisting of the general superintendent of transportation, the general superintendent of motive power, the engineer maintenance of way, the purchasing agent, the auditor of disbursements, and the superintendent of fuel conservation, and fuel committees on each division consisting of division officers, enginemen, trainmen and others. This General Fuel Conservation Committee has to do with purchase, inspection, storage and handling of coal, including all feasible economies that can be effected. The duty of the division fuel conservation committees is to study in more detail the ideas of the General Fuel Conservation Committee and general officers, circulate the results obtained by individuals as well as to instruct as to best methods to be used.

On the Illinois Central System we conducted a fuel conservation campaign throughout September and October, 1921. Enginemen and trainmen on the same terminals competed with one another, and divisions competed for rank. Daily reports of fuel consumed in freight, passenger and yard service were obtained from all divisions, and reports showing the number of pounds of coal consumed per 1,000 gross ton miles, per 100 passenger car miles and per yard engine mile for all divisions were promulgated daily. The campaign

was an interesting and successful one and produced a saving on our lines of 30,000 tons in one month alone. I attribute the success of the campaign to the initial interest taken by enginemen, trainmen and other employees concerned in fuel consumption, and the spirited competition which resulted from posting individual accomplishments. Of course, the local officers must be duly credited for the intensive interest developed in preparing for and during the campaign.

I do not want to be quoted as saying that fuel conservation results are entirely in the hands of the men and local officers. There are a great many things for the managements of the railroads and other properties to consider and act upon. We must have fuel inspection at the mines, and, where coal is placed in storage, it must be scientifically handled to insure economical and proper results. Our purchasing departments must surround the purchase of coal with recommendations made by men competent to pass upon the grades and preparation of coal. Power plant and station use of coal on some railroads warrant specialized supervision, with a man in charge who is thoroughly trained in power plant operation.

Distribution of coal needs close supervision. It is sometimes necessary to burn various grades of coal on a railroad. Under such conditions the distribution should be regular. Proper tonnage rating of locomotives is a factor. Where engines can be assigned to individual enginemen it will go a long way toward conserving fuel because of the personal interest the enginemen manifest in the condition of the engines assigned to them. Efficient yard operation and dispatching of engines and trains, as well as not overloading the tenders, are important features. In fact, nearly every phase of operation is directly or indirectly related to fuel consumption, and it is this relation that must be considered to get the desired result.

Our mechanical departments must understand that they are largely responsible for fuel conservation or waste, at least to the extent that they are permitted to spend money. An engine that does not economically burn coal should be kept out of the service until conditioned. We have on the market a number of devices and improvements which have been demonstrated as coal savers. All may not agree on the merits of these devices, but I think it is well worth every mechanical man's time to watch and study the development and performance of every improvement and device designed to save coal.

Stationary boilers must be kept in good condition and a systematic method of inspection and to insure economical operation, and the results obtained posted to promote interest of the operators.

Further, roundhouse equipment, such as hot water boiler washing plants, water treating plants, plenty of ash pit room and modern coaling stations are important. These, of course, are expensive items, but the savings produced as a result of such expenditures have demonstrated that it is money well spent.

Our existence today depends upon coal. It moves our commerce. It prepares our food. It heats our offices and homes. Just because we see it in large volume should not detract from its value. It should be indelibly impressed on the minds of everyone that fuel conservation is needed and

can be accomplished to a large extent, and that the money so saved can be applied to the general good of the properties upon which we and our families are dependent for a livelihood.

President Robinson spoke in part as follows:

### President's Address

**F**UEL economy was long considered purely a mechanical department matter, but this association has for years advocated the policy of arousing all the departments to a realization of their share in the responsibility. There are at present many of our members, who may be classed as transportation or operating officers and much has been gained through papers and addresses delivered at previous meetings by general managers, general superintendents and other operating officers.

It is most encouraging that the executives of our railroads through the American Railway Association have so fully recognized the magnitude of the fuel problem and have urged and encouraged all departments toward greater interest in fuel conservation.

The Fuel Association's Committee on Fuel Tests in conjunction with the University of Illinois, and the United States Bureau of Mines, completed during 1917 at the locomotive testing laboratory of the University of Illinois, a series of tests of six sizes of coal from the same mine located in Franklin County, Ill. These tests developed that on a modern Mikado locomotive at the high rate of evaporation the 1¼ inch screenings are worth only 94 per cent as much as 2 in. screenings for stoker firing; and 2 in. screenings only worth 87 per cent as much stoker fired as mine run hand fired.

It was the original intention that similar and additional tests be made of coal from the various fields throughout the country. Due to the war, the matter has been held in abeyance, but within the past year the Special Committee has suggested to the American Railway Association that a continuation of the tests would be desirable and it is hoped that favorable consideration will be given this matter at an early date.

While little accurate data has been made public other than the University of Illinois tests, already referred to, concerning the relative efficiency of various sizes of coal, it can be stated that the matter of size depends to a large extent on the description of the coal considered, whether low or high volatile, coking or non-coking. However, from the results of the laboratory tests at University of Illinois as well as various road tests, it may be definitely stated that the physical characteristics of coal constitute a factor equally as important as the B. T. U. value in so far as concerns the effective burning of coal on grates in locomotives. The coal mining interests can do much to assist the railroads in reducing fuel consumption through decreasing the stack loss, by furnishing them coal with as low per cent of fineness as practicable.

It would appear that the railroads can with profit frequently conduct road tests to determine sizes best suited to their needs, and some roads have given consideration to this feature.

It may be of interest to mention briefly the results of some road tests which may serve as suggestions for further checking by laboratory tests, similar to those which have already been mentioned.

**Comparison of Two Varieties of Coal in Two Sizes:** A Mikado locomotive, 26 in. by 32 in. cylinders, 64 in. drivers, 54,587 lb. tractive effort, equipped with superheater arch and Street stoker, was tested on the road with dynamometer car and test conditions controlled as closely as practicable. Two varieties of coal in two sizes for each variety were used stoker fired in order to determine their relative econ-

omy. Description, proximate analyses and comparative performance of the coals were as follows:

	Fairmont high volatile		Myersdale low volatile	
	1½-in. N. P. & S.	¾-in. Slack	Mine run	1½ in. Screenings
Moisture .....	1.23	1.57	0.75	0.81
Volatile .....	36.47	35.74	18.17	17.52
Fixed carbon .....	53.94	52.78	69.07	70.06
Ash .....	8.36	9.91	12.01	11.61
Sulphur .....	2.59	3.30	3.33	2.31
B. t. u. (calculated) .....	13,100	12,900	13,800	13,870
Lb. coal per avg. h.p. hour.	3.74	4.19	4.14	4.89
Equiv. evap. lb. water per pound of coal .....	6.71	5.98	6.62	5.50
Efficiency of boiler .....	46.6	41.9	46.1	38.0
Lb. coal per sq. ft. grate per hour .....	57.78	65.89	59.55	74.28
Value based on 1½-in. N. P. & S. 1.00 .....	1.00	0.89	0.99	0.82

These tests indicate clearly the desirability of high volatile coal of as large size as permissible on stoker locomotives requiring screenings, unless length of haul or other factors make ultimate cost of low volatile coal equal or less.

**Comparison of Two Mine Run Coals from Different Mines in Same Region:** Similar tests were made of mine run coal (crushed by stoker in firing) from two mines producing from the same vein of coal but from different parts of the field. The coals were similar in analysis and heat content.

The results obtained showed that coal A was decidedly more economical. Consumption of coal B was about 15 per cent in excess of coal A per D. B. Hp. Hour. Equivalent evaporation with coal A was 17 per cent greater than with coal B. Boiler efficiency with coal A was about 16 per cent higher than with coal B. Coal B was the more friable coal running about 75 per cent slack, which is characteristic of the coal while coal A ran about 45 per cent slack.

**Mine Run Coal Versus Two Inch Screenings:** Dynamometer car tests were run with a Mikado locomotive of recent design under comparative conditions in slow freight service to determine the relative economy of high volatile mine run coal and N. P. & S. screenings from the same mine when the locomotive is equipped with the duplex stoker. The mine run coal averaged 45 per cent slack, the N. P. & S. screenings averaged 65 per cent slack, with average proximate analyses very nearly the same.

The results showed the following relative performance:

	N. P. & S.	Mine run	Per cent in favor Mine run
Pounds coal per h.p. hour .....	2.98	2.72	8.1
Pounds water per lb. coal from and at 212 degrees F. ....	8.44	9.59	13.6
Efficiency of boiler .....	58.18	66.04	13.5

These tests would indicate that stokers of type that can be supplied with mine run coal, might profitably be substituted for one requiring a special size coal or screenings.

The cost of fuel and the wages of train and engine crews totals 50 per cent or more of the expense of our railroads for conducting transportation. (Cost of haul of fuel over own lines is not included in total audited cost, but is a considerable item in connection with conducting transportation expense). The fact that the volume of traffic at present being offered for movement does not by a material amount approximate the capacity of the available transportation facilities, results in present average operating conditions under which congestion is largely eliminated.

The opportunity to reduce overtime wages and standby fuel consumption through reduction of delays on line of road and extension of locomotive runs through intermediate terminals is presented by these conditions and many railroads

are taking advantage of this opportunity to reduce the transportation expense.

Caution is required, however, to insure that the increase in speed of movement is not made at the expense of too great

a reduction in the train load. The index of gross ton mileage produced per unit of combined wage and fuel expense should be employed as a check to determine the relative economy of performance.

## Locomotive Fuel, the Life Blood of Transportation

By G. M. Basford

Consulting Engineer, Lima Locomotive Works

**F**UEL is the very life blood of transportation. We must use it as if we thought so. We must not treat it as we are tempted to treat water in the rainy season. We must not burn it as if there were a lot more where this came from.

Before those who direct and control the use of fuel on railroads lies a wonderful opportunity for money making, money saving. Wonderful improvements have already been made. More and even greater possibilities are available.

A fortunate fact about every feature in fuel conservation is that it helps railroad operation in ways that fuel does not directly touch. No one ever does anything to make more effective use of fuel without helping the road in other ways. Therefore, to co-ordinate all these possibilities and to organize the road into a Committee of the Whole to conserve fuel, fuel officers need to be very big, broad, influential men. They need to grasp and improve to the utmost the opportunity that lies before them. It is fortunate that they now have this opportunity and this wonderful organization back of them.

Fuel must take a new place in your hands. The fuel officer who is to bring fuel to its proper eminence has many strings to his bow. The fuel officer has back of him the locomotive builders with their extraordinary experience. He has many other supporters who have spent lifetimes in developing safe, sound and sane vitalizing factors that have never yet been employed to the limit of their capacity for improving the real efficiency of locomotives. He must also have the entire railroad back of him.

When business comes on again, look out! You have less railroad today than you had five years ago. You are short about 5,000 locomotives to keep the equipment curve anywhere near the curve of growth of the nation. C. B. Peck and V. Z. Caracristi show that locomotives are not used as efficiently now as they were 20 years ago, because of lack of maintenance facilities, but we know that as machines they are vastly more efficient. It is also clear that lack of adequate shop facilities is a great factor obstructing the application of fuel saving, capacity increasing improvements to locomotives now in service, each of which should, if run at all, run as economically and as efficiently, weight for weight, as the latest new power. These unmodernized engines are wicked wasters of fuel. To fix this situation right, new shop machinery is needed. This illustrates the breadth of the opportunity of the fuel officer. Adequacy of the equipment of shops affects his fuel record in several ways. It materially affects the number of new engines needed and controls the improvement of old ones. It also controls the condition of the power that is burning up his fuel.

As a railroad officer, acquire all the knowledge of the latest locomotive progress, learn of the perfectly sane and safe possibilities of power and its use, never yet put into general practice, and knowing to your own satisfaction that big improvements may be made, you may say, "As a railroad officer I cannot afford not to see this done." To the public the new locomotive and upkeep of present locomotives are more important than the question of rates and will continue to mean more to the public as to their own pockets, but the public does not know it.

### Purchasing Agent

Why not help him by showing him what coal to buy and why let him supply unimproved real estate? Thirty-two years ago a big western road, then poor, now very prosperous, tested seven coals for main line service. Differentials in price were established. Poor local coals were discarded and truly economical coals provided. Operation of the road instantly reflected the value of the right fuel. Nothing means more than this in making long locomotive runs. Careful roads buy the coal that is cheapest in the end. They pay more to get clean coal and save by doing it. Then the coal should be uniform or locomotives cannot be kept right as to drafting. Drafting has been a difficult problem on many roads. Changing coal discourages efforts to keep front ends "right."

### Yardmaster

Give this very efficient officer the kind of switch engines he needs; powerful, efficient, economical, snappy ones. Give him road engines that will clear the ladder tracks quickly. He knows, better than anyone else, the value of locomotive improvements that make for better acceleration of trains over the tracks that tie up the yard until they get away. Then watch him make up trains for an even load on the road, avoiding fleeting. Bunching trains raises havoc with fuel performance. Watch him send road engines back to the roundhouse singly, again avoiding the fleeting that clogs facilities of all kinds, particularly locomotive terminals, and piles up stand-by losses.

Do you not think that you can classify trains at terminals so as to main track some of them through other terminals? One road does this with 10 to 15 per cent of its freight trains. Avoid switching trains at terminals whenever possible. This makes for long runs.

### Dispatcher

No one can do more for fuel than this officer when he has the tools to work with. Everything he does for fuel does even more for himself. He does not want to fleet trains. He wants them to get away and run. He needs efficient power, first in the yards and then on the road. He needs such tonnage rating and careful loading for all engines as will enable him to give a track for the big powerful ones to use without being checked and harassed by old unmodernized ones. He knows that it costs from 500 to 1,000 lb. of coal to stop a train and start it again, depending on how long it stands, but often he cannot help it. Take the dispatcher into the family and give him the best tools to work with. Then get him to use his engines with the realization that they are very costly and very scarce and that every lump of coal is precious.

Scheduling freights is a great improvement. Send them out at specific times worked out to suit conditions and to keep the wheels turning, avoiding delays of all trains as much as possible.

### Superintendent

Knowledge and thorough knowledge of his locomotives means more to this officer than to any other on the road, even those who are responsible for locomotives themselves. Under

his command are all those who use the power. When he has the traveling engineers he controls, and is in position to revolutionize locomotive handling and operation. He can control dispatching, control condition of power, direct firing and the use of locomotive cut-off. He more than any other officer can aid in making long locomotive runs and in providing equipment, men and supervision for locomotive maintenance and terminal attention. Superintendents also control the time lost at stations that must be made up by fast running that uses so much fuel. They are charged with fuel cost. They can do more than anyone else to save it.

In the superintendent the success of the divisional organization lies. Help him. Show him how the locomotive may help him.

### Track Officers

Limitations of locomotive weight are sometimes arbitrary, but the tendency toward reducing dynamic augment, through lighter reciprocating parts, renders it possible to build even more powerful, more economical locomotives without requiring heavier rail and stronger bridges. Weight limits often prevent application of fuel saving improvements. The limit to locomotive capacity has not nearly been reached, but co-operation and understanding of this problem on the part of track people will be necessary. It will pay to relocate some water plugs, to change positions of some sidings for the sake of fuel. Improved acceleration of trains with a recent locomotive improvement has already affected these matters materially on a number of roads and will affect them much more. Track officers will find that locomotive improvements, other than light parts, will help them by avoiding the necessity for heavier rail and bridges. On the other hand they will find that they may do many things with track that affect fuel. They should interest themselves in what is happening to the locomotive, particularly as to application of the booster and reducing dynamic augment.

### Signal Officers

These men know the cost of stopping trains. They are helping fuel by keeping trains moving. A new and vital problem lies before them. It will be up to them to secure the necessary safety from automatic train control without unnecessary stopping of trains. Get them into the fuel family as to the effect of this new development on the operation of trains of 60 to 100 cars and also as to the possible improvement of an occasional signal location. The possibility of increased acceleration of trains will affect these locations materially.

### Mechanical Officers

When everybody else thinks of fuel, when the "business of owning locomotives" is understood and appreciated, when ultimate cost replaces "first cost" in the official mind, and when necessary improvements in accounting are made, mechanical officers will surprise everybody with the savings they will render possible. They will do it with modernized existing locomotives, with new and greatly improved locomotives, with competent maintenance, with tonnage ratings that mean maximum earnings. Their problem must be understood. They must have facilities, help, encouragement and support. They are ready, but they and their problems are not understood.

### Condition of Power

A well known locomotive superintendent 15 years ago did a great thing to improve condition of power. He put several men in charge of matters that make or break fuel records.

1. Front ends, drafting engines for economy as well as for steam, air leaks into front ends and condition of superheaters. One man had charge of these.

2. Valve motion, best setting of valves for every class of engine and for every service was determined and it was this

man's job to see that every engine on the road had economical and effective valve setting and that it was kept that way.

3. Boilers, this man was responsible for tight boilers, for clean flues and arch tubes, for grates, arches and ash pans.

4. Running gear, every box, pin, journal, shoe and wedge, was the responsibility of this expert. He supervised the shop and roundhouse work all over the road and had lubrication in charge.

These men had authority. At times they annoyed the master mechanics, but that was the reason for their appointment. Remarkable results were reported. Any road may do this. It means little in cost, but much in fuel. This is a good way to avoid fuel loss by leaky front ends, nozzles too small, leaky superheaters, fallen arches, leaky flues, hot boxes, knocking driving boxes and other things that defeat the best fuel efforts. Today, stokers, feed water heaters, grate shakers and power reverse gear would be added to the list, making it somebody's particular business to look after every one of them systematically.

Existing engines require this. As soon as the "bloom is off the peach" new ones need it also. Large capital expenditure is needed for the necessary maintenance facilities. The public has made it difficult for poor roads to raise the money, but a great deal may be accomplished by a gradual and relatively slow process, each step of which will make the next one easier. Get rid of the fatal monthly budget. Get to an annual basis. Consider annual cycles instead of straight line oversight. Do a little this year and invest the savings of this year for the time to come.

If our shops and roundhouses had adequate machinery and facilities for handling big work quickly, if they had enough to modernize all existing engines and to keep all engines up to condition there would be a surplus of power today for any load the roads have ever had to carry. This, however, will not provide for the load that is coming. New engines will be needed before they can be designed carefully to take advantage of available improvements, and before they can be built. But remember that the new ones will soon add to the shop load. There is no time to lose in this machinery matter or the loss to the public will bring the severest charges railroads ever faced. A new way for financing machinery additions must be found. This is now receiving attention with promise of success. Last February Secretary Hoover suggested government guarantees for improvements and equipment.

### Engine Failures

Records for nine years on a well known road show 84 per cent reduction in the number of engine failures per month that cause a delay of five minutes, whether made up or not. Remember that time made up on the road is mighty costly in fuel and it should count against any failure that causes it. In the nine years referred to the number of engines dispatched per engine failure increased 251 per cent. Figuring on \$250 as the average cost of an engine failure, and the cost may often reach five times that amount, this road estimates a saving of a quarter million dollars per year, and relatively it is a small road. An engine failure may cost \$1,200 if it delays four or more trains. The particular failure that showed this figure could have been prevented by an expenditure of \$25.

### Long Locomotive Runs

Stand-by losses murder fuel records. Is yours as high as 30 per cent as it was recently stated to be on one big road? Popular demand for economies and growing public sentiment in favor of the operating economies of electrification have some foundation in view of the possible continuous service of electric locomotives eliminating stand-by losses. Eight hours a day or perhaps half that, ought to be enough to condition a locomotive, leaving 16 or more, for service. It is not the fault of the engine that it does not work more

than 16 hours or that it spends more than half its life at rest. After 150 miles the engine is well warmed up for another 500 miles.

### Individual Fuel Records

Without individual performance records it is impossible to check tonnage performance of engines, to check up the value of vitalizing factors and to know whether the power improvements and economy they should give is really produced. A combination of four vitalizing factors should give the light government Mikado 50 per cent additional pull at 30 miles per hour for the same coal as a plain engine of the same size would use. Do we get this power? Only individual records of fuel and tonnage will show. J. N. Clark covered this question admirably before the Pacific Railway Club last year. He asks how the traveling engineer is to know what to say to 125 engineers and 140 firemen unless he knows what each one is doing?

He also asks: "How long would a large industrial plant remain a going concern if they had one item of expense amounting to 40 per cent of their operating expenses and had no idea as to whether it was sustaining a loss each month due to lack of supervision over details?" W. L. Robinson covered this subject in his paper before the New England Railroad Club in December, 1917.

By a few simple figures every run may be made a test run. We do this with automobiles. Any deficiency in miles per gallon leads to a prompt investigation because it touches our own pocketbooks. Some tests made three years ago proved 20 per cent in fuel saving by an improvement on a big engine, but it did not show on any record except that of the test. When a new type of engine goes to work it is most important to know its operating and fuel standing as compared with those that it replaced. This would help in ordering the next new ones. Those who do not know cannot wonder why new engines are ordered without consultation with them. Some general office buildings have four and five floors of accountants. Is it not possible to divert a few accountants to the vital statistics needed for locomotive operation, to make every run a test run, even if it is a rough test?

### Co-operation of Engine Men

The major number of engine men take pride in their work. Their co-operation is a vital matter. They are intelligent, able men, but don't ask them to save fuel while someone else who directs their work wastes it faster than they can save it. Give them a chance to run. Give them a railroad to run on, give them track, give them signals and water plugs where they ought to be. Then show them films such as the "Fuel Conservation," films of the Southern Pacific. They would co-operate and turn their daily routine to the advantage of the company. Are your engine men with you as to fuel? Have you a right to expect them to be? Do you keep records of individual tonnage and fuel so that the good men can make a showing and so that the others will be encouraged to try?

### Stationary Power Plants

Over 1,200 railway power plants offer opportunities for a lot of fuel saving. Heat losses alone account for 25 per cent of the fuel in the average steam plant without referring specially to railroad plants. Do we give careful attention to the operation of shop power plants to see what the firemen are doing? Do we train and do we check up power plant engineers and firemen? Do we keep brickwork tight? Do we apply superheaters and do we cover piping and stop the leaks of steam, water and heat? A few years ago a large manufacturing company saved ten per cent of its fuel in a large plant by merely stopping leaks. What could railroads save by covering pipes, stopping leaks and by replacing old locomotive boilers by proper boilers with superheaters for stationary plants?

### Boiler Water Treatment

A very costly encumbrance is boiler scale. Many a railroad is regularly using waters not fit to be put into boilers, locomotive boilers least of all. It costs little to "doctor" those bad waters, little compared with the cost of driving heat through boiler scale which is the most effective heat resister known. For the benefit of your fuel records "medicine" these bad waters.

### Personnel

It's the personnel of an organization and the skill and spirit of its members, the team work, that gets the results, good or otherwise, out of any equipment—army, navy, manufacturing or railroad. Hand in hand must go improved men, improved supervision and improvements in material. To be ready for better locomotives it is necessary to lead men to bring the present equipment and its use to a point of high efficiency. Improve the men and when they get the best work out of present machinery they will be ready for better machinery. A suitable plan for recruiting, training and promotion of men—real apprenticeship—is the thing railroads need more than any other one thing today. What are you doing about this? Ask the roads that have systematically provided apprenticeship whether it pays. Ask the Santa Fe people. Only one road has applied this year to a certain famous technical school for some of its graduates. Was it your road?

### Morale

Morale is the first thing to fix. Perhaps by inspired leadership this may be accomplished. Leaders always know what they want and how to get it. Everybody sees coal come in quantities by train loads. Is it not possible by leadership to induce everybody to use it as if it were their own?

### Those Next New Locomotives

To order new engines now is a big responsible job which should be approached with full knowledge of the business possibilities of locomotives reinforced by experience and willingness to take advantage of everything that will produce efficient engines that will save money. There is little danger of going too far in refinement. There is great danger of perpetuating the brutal in present locomotive practice.

### Unnecessary Weight

This is the first big thing to tackle. Many big engines today are doomed to carry literally tons of unnecessary weight, and to carry them for 20 or 30 years. Think of the fuel required to drag the heavier engine around. Many engines have been built recently that were too heavy to take important fuel saving factors. Here is where the fuel officer comes in on refinement of present brutal weights. He comes in again in saving of fuel by long locomotive runs to which refinement of design and better steels will contribute. One railroad has gotten down to less than 100 lb. of weight per horsepower. Is it your road? There must be a definite weight limit or your fuel records suffer.

Undoubtedly the new engines will have trailing wheels. Boosters add to capacity, produce quicker acceleration to speed, help over critical points on grades, clear yard ladder tracks in shorter time and really put a trailer type of engine into the next class above it in starting power. It saves fuel by avoiding doubling and by putting a light engine in position to do the work of a heavier one. You should consider building Atlantics today with boosters for suburban and frequent stop service, releasing heavier engines and make a little money on such trains.

Stokers should be considered for new engines in a new way—as fuel savers. They are generally advocated to throw more coal than a man can fire. They should be used as fuel savers, enabling the fireman to use his head when he is re-

lieved from the heavy work of firing. Power grate shakers reduce the starving of a fire for air. They are needed to make long runs and to facilitate cleaning fires. New engines call for most careful attention as to lubrication. Long runs already made prove this necessity. Heat conservation by feed water heaters will add to the power of the new engine or save fuel for the same power. Feed water heaters have been demonstrated to be a success and should be considered on every new engine.

All new engines have arches, but a new and double arch is available. Through its supporting tubes water equivalent to the entire contents of the boiler will circulate every seven or eight minutes when the engine is working hard. So also the thermic syphon is available. Their effect on combustion and also their influence on improved circulation must be considered. Boiler circulation may be accelerated in several ways. New engines with necessarily big boilers should have the fuel saving advantage provided by them. With improvements of this class circulation may be so rapid as to require steam separators to prevent the superheater from being compelled to evaporate water. This question will be answered soon. To help boiler circulation, reduce boiler repairs and reduce engine failures why not use ten or 12 inch mud rings?

No engines are built in these days without superheaters, but new ones should have the advantage of higher superheat and superheated steam for the auxiliaries which altogether use a lot of steam. This should save many a ton of fuel. This is now being worked out with promise of success.

Improved valve gears and power reverse gears are necessary on big engines. Cut-off control is only now becoming appreciated as a fuel saver and power increaser. The power

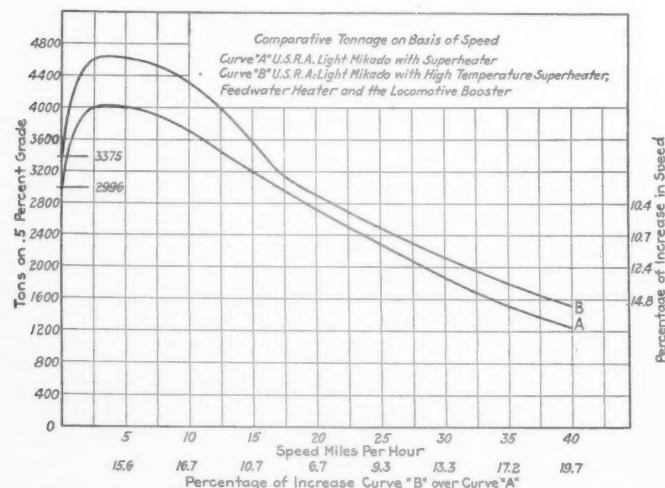


Fig. 1—Effect of Fuel-Saving Appliances on Tonnage and Speed

Curve A indicates the maximum tonnage which can be moved on a 0.5 per cent grade by the U. S. R. A. light Mikado at various speeds; while Curve B represents the possible increase in tonnage which may be obtained by equipping this locomotive with a feedwater heater, high temperature superheater and the locomotive booster.

The increased capacity, as shown by curve B, may be utilized in increased speed of operation, as indicated on the right margin of the diagram; for instance, the speed of a 1,600-ton train may be increased 14.8 per cent.

reverse gear that is to do the work on future big engines must be able to run for long periods without attention and without creeping. Such a gear is now available. For very powerful freight engines the 50 per cent maximum cut-off which has been so successful on the Pennsylvania should be taken into consideration, and after that comes the three cylinder engine to bring bearing pressures down.

This is not by any means a complete list. Skillful combination of design using these factors and others will produce locomotives that will surprise everybody. Up to the time this is written the locomotive that uses all of these,

combined with skillful detail design, unrestricted as to first cost, but constructed for ultimate cost and operating economy, has not been built.

### A Prediction

We think we know the locomotive. We do not. We will not until a certain thing is done that has never yet been done. Put this up right and you will get it.

Give an order to one of the three locomotive builders, or better give one to each of them, such an order as you give to electric locomotive builders. Give an order for a new locomotive for certain traffic on your road. Make no limit on price, but order the most economical engine that can be built for that work, all things considered, ton-miles per hour, per ton of locomotive metal, per dollar of locomotive mainte-

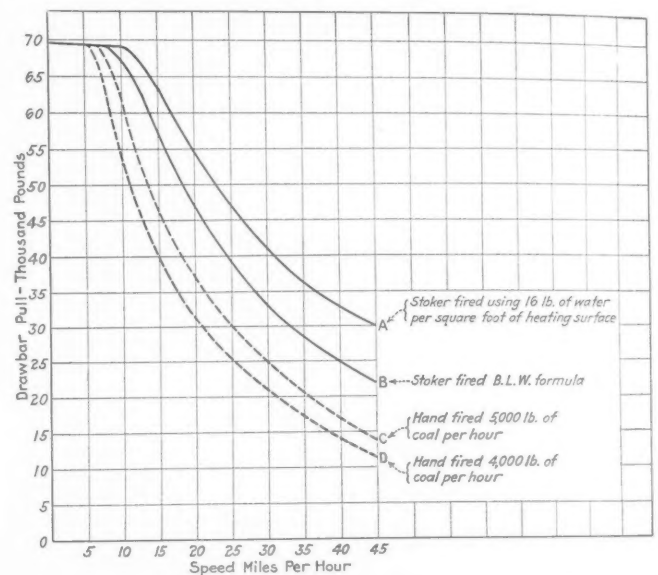


Fig. 2—How Stokers Increase Tractive Effort of Large Locomotives

The capacity of a fireman is limited to about 4,000 lb. of coal per hour over considerable periods; for short periods a man can fire at the rate of from 5,000 to 6,000 lb. per hour.

Curves D and C indicate the drawbar pull on level straight track that can be expected from the U. S. R. A. heavy Santa Fe type locomotive with hand-firing at the rate of 4,000 and 5,000 lb. per hour, respectively.

Curve B illustrates the normal output in drawbar pull of this locomotive as rated by the builders when it is equipped with a mechanical stoker; this involves an evaporation of from 12 to 13 lb. of water per square foot of heating surface and fuel consumption of about 120 lb. per square foot of grate per hour.

Curve A indicates the increase in drawbar pull over the normal capacity which may be expected when the boiler is forced to about 20 per cent beyond its normal capacity.

It will thus be seen that in emergency the stoker can be used to increase the locomotive capacity, although it should be borne in mind that such increase is obtained at a loss in efficiency.

nance and per dollar of track maintenance cost. Enlist the leaders and best engineering talent of the solid, reliable, reputable companies producing the vitalizing, capacity increasing and fuel saving factors that render the modern locomotive possible. Tell all hands, without exception, to cut out every pound of unnecessary weight and make every one of them do it. They will do wonders in this direction when they must. They have never yet been made to do it. But the builders can do more than all the rest. In all things insist on efficiency. Use alloy steels whenever possible, but do not take a chance on anything that has not abundantly made good. Above all things insist on quality material everywhere and get it, as you do when ordering electric locomotives.

When this engine is delivered take good care of it, but make it work every possible minute as every machine should work. Put an experienced man on the job of following the engine to see that it has a "show," as the electrical people do when they install electric locomotives. Then see to it that operation is made to fit the locomotives as the electric loco-

*motive people do* and thereby correct a lot of faults that steam locomotives have always had to endure. Keep track of the tons of freight, fuel, water and the time. Get the dispatcher to give the locomotive the rails to run on, show the men how to run it and then give the right amount of thought to its maintenance.

Then tell the chief executive the results in money saved. He will tell the "Board" the same day. That day will begin a new kind of money making railroading.

Some new, quick, deep, intensive thinking on the locomotive is needed and needed now.

This is an effort to interest real railroad men in some things they are overlooking. It is a challenge for the short-sighted gentry who refer to important locomotive improvements slightly.

Look, think, act. When you build new engines build ten that will do the work of 20 old ones and cost less to keep up.

Who orders new engines on your road? When he orders two million dollars' worth of engines get him to see how much efficiency he can buy instead of how many engines he can get for his money without regard to their efficiency.

[Accompanying Mr. Basford's paper were numerous charts showing the effect of fuel-saving devices on tractive effort, tonnage, speed, fuel and water rates and acceleration. Two of these charts are reproduced in this abstract.—EDITOR.]

#### Discussion

H. C. Woodbridge (Locomotive Stoker Company), said that fuel economy must be considered in connection with other operating costs as well as with considerations of revenue, calling attention to the fact that while stokers have not generally shown as good an evaporate efficiency as hand firing, they have actually reduced ton-mile fuel costs. Recent tests, however have demonstrated that the stoker can actually increase the evaporation per pound of coal over that obtainable under comparable conditions by hand firing.

#### Pennsylvania—Labor Board Dispute

The legal controversy between the Pennsylvania and the Labor Board, was re-opened on June 2, when hearings were held in the United States Circuit Court of Appeals at Chicago, as the result of an appeal from the recent decision of Federal Judge George T. Page. Judges Baker, Alschuler and Evans heard the arguments by Messrs. Blackburn, Esterline and W. D. Riter, representing the Labor Board, and T. J. Scofield and J. B. Heiserman for the Pennsylvania.

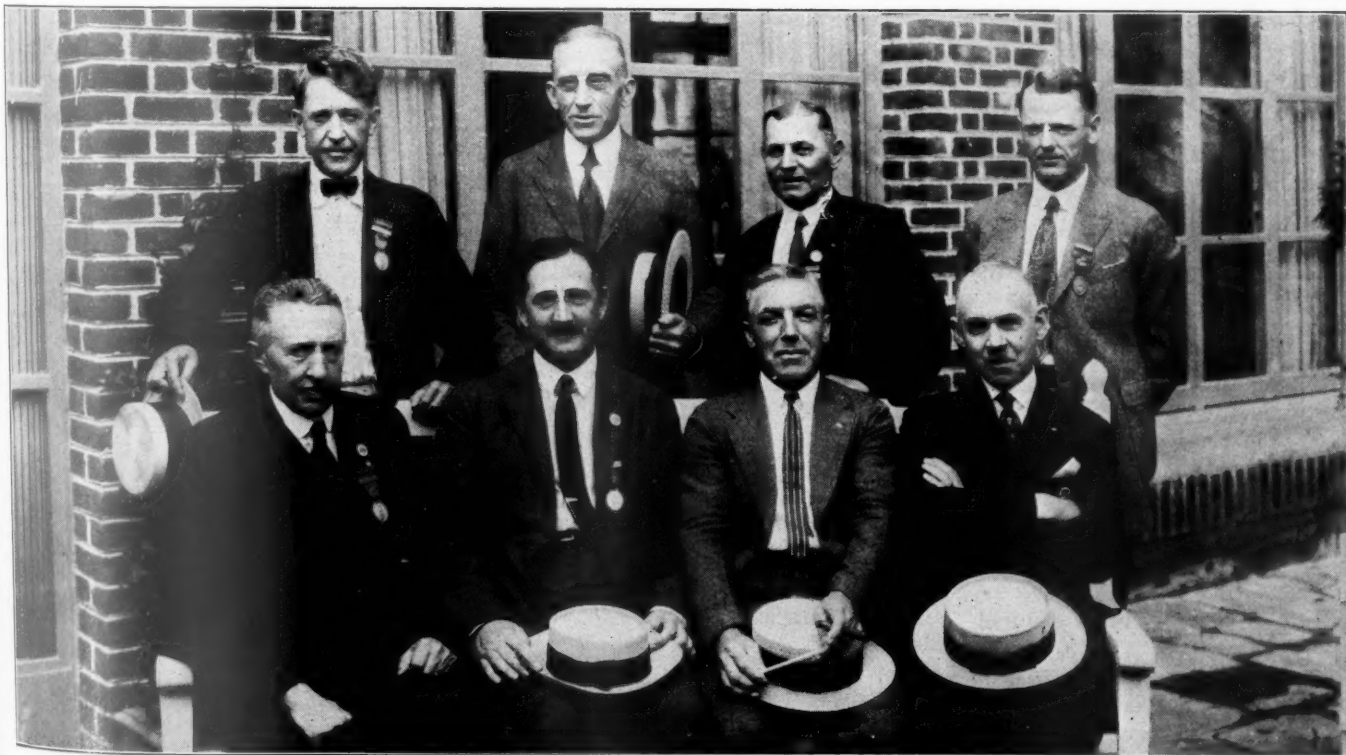
In making the closing argument on behalf of the Board, Mr. Esterline held that the Board is an arm of the government, analogous to the president or committees of Congress and that, therefore, the Board could not be sued or enjoined. He pointed out that the injunction issued by the Circuit Court, restraining the Board from issuing a decision inimical to the Pennsylvania's interests, stated that the Board's powers were only advisory. He therefore declared advisory powers could not be enjoined any more than the President could be enjoined from submitting a message to Congress or a congressional committee from reporting its recommendation.

These contentions apparently did not meet with the approval of Judge Baker, who said:

"I do not consider that that question is involved. The fundamental question is whether the Board acted within its jurisdiction in its order to the railroad and, if it did, whether or not the power under which it acted is constitutional."

Mr. Scofield and Mr. Heiserman for the Pennsylvania, argued that the Board acted without jurisdiction in issuing the order and while admitting the right of the Board to prescribe just and reasonable rules, denied the Board's power to direct how the rules governing employees should be made. The arguments of the railroad's and the Labor Board's attorneys followed the arguments in previous hearings.

The court subsequently took the case under advisement and Mr. Esterline announced that if the injunction is upheld the Board will carry the case to the Supreme Court.



1922 OFFICERS OF THE AIR BRAKE ASSOCIATION

Seated, left to right: Mark Purcell, first vice president; L. P. Streeter, president; George H. Wood, second vice president; R. C. Burns, executive committee. Standing: M. S. Belk, executive committee; F. M. Nellis, secretary; H. L. Sandhas, executive committee; H. A. Clark, executive committee.

# THE QUESTION BOX

## Design of Crank-Pin and Crank-Pin Hub

### A Solution of the Problem

By H. J. Coventry

*This is another answer to the questions published on page 202 of the April issue. A previous answer was published on page 330 of the June issue.*

1. Fibre stress in crank-pin hub due to pressing in the pin with a pressure of 140 tons: It can readily be seen that the load required to press pin into hub is equal to the holding force of hub multiplied by the coefficient of friction, or  $W = P \times u$ .....(a)

Taking  $u = .25$ , the value of the gripping force of hub is found thus

$$\frac{2,000 \times 140 = P \times .25}{P = 1,120,000 \text{ lb.}}$$

This force will act normally to surface of pin if the pin fits throughout its surface. Therefore, pressure per square inch of surface of hub bore is

$$\frac{P}{\text{area}} = \frac{1,120,000}{7.5 \times \pi \times 7} = 6,790 \text{ lb. per sq. in.}$$

Now this pressure acts upon the hub similarly to fluid pressure in a thick cylinder, the maximum skin stress occurring on the inner surface and its value may be found by the formula of Lamé.

$$f_1 = p_1 \frac{r_1^2 + r_2^2}{r_1^2 - r_2^2} \text{.....(b)}$$

here  $f_1$  = Stress lb. per sq. in. on inner surface of bore  
 $p_1$  = Pressure lb. per sq. in. on inner surface of bore  
 $r_1$  = External radius of cylinder or hub  
 $r_2$  = Internal radius of cylinder or hub

$$\begin{aligned} \text{In our case } f_1 &= 6,790 \left( \frac{6.75^2 + 3.75^2}{6.75^2 - 3.75^2} \right) \\ &= 6,790 \times 1.895 \\ &= 12,833 \text{ lb. per sq. in.} \end{aligned}$$

(2) Maximum pressure at which crank-pin can be pressed in without causing hub to burst: The material of pin-carbon steel forging has an ultimate strength of 80,000 lb. per sq. in. with a yield of 40,000 lb. per sq. in.

The cast steel of hub has 65,000 lb. per sq. in. ultimate, 29,200 lb. per sq. in. yield and elastic limit 26,000 lb. per sq. in.

To find maximum pressure which hub will withstand, substitute stress at elastic limit in above equation. Then

$$\frac{26,000 = p_1 \times 1.895}{p_1 = 13,720 \text{ lb. per sq. in.}}$$

That is intensity of pressure between hub and pin may be 13,720 lb. per sq. in. without bursting hub.

$$\begin{aligned} \text{Total holding force} &= 13,720 \times \text{surface of pin} \\ &= 13,720 \times 7 \times 7.5 \times \pi \\ &= 2,270,000 \text{ lb.} \end{aligned}$$

Driving or pressing force required

$$\begin{aligned} &= \frac{2,270,000 \times .25}{2,000} \\ &= 282.5 \text{ tons} \end{aligned}$$

Or this pressure may be found directly thus

$$140 \times \frac{13,720}{6,790} = 282.5 \text{ tons}$$

(3) Fibre stress in hub due to pressing in pin plus stress

due to thrust from main rod: To find the force acting at hub take moments about  $w$ .

$$\frac{W \times (9.75 + 7)}{w} = w \times 7 \text{.....(c)}$$

This force tends to tear the hub apart across a diameter and the area of metal supporting this force is

$$2 (3 \times 7) = 42 \text{ sq. in.}$$

Load  $W$  on pin due to piston thrust

$$\begin{aligned} &= \frac{25^2 \pi}{4} \times 180 \text{ according to data given} \\ &= 88,356 \text{ lb.} \end{aligned}$$

$$\text{Stress on hub} = \frac{2,392 \times 88,356}{42}$$

$$= 5,020 \text{ lb. per sq. in. tension}$$

Total stress on bore of hub due to thrust of piston and pressure of fit of pin =  $12,833 + 5020 = 17,853 \text{ lb. per sq. in.}$

(4) Strength of pin:

Bending moment = fibre stress  $\times$  modulus of section or

$$W \times l = f \times \frac{\pi d^3}{32} \text{.....(d)}$$

Here  $W$  = piston thrust  
 $l$  = distance between lead and point considered  
 $d$  = diameter of pin in inches  
 $f$  = stress lb. per sq. in.

$$\text{then } 88,356 \times 9.75 = f \times \frac{\pi \times 7.5^3}{32}$$

$$f = 20,800 \text{ lb. per sq. in. at largest diameter.}$$

The fibre stress at any other diameter along the pin may be found similarly.

At end of  $7\frac{1}{4}$  in. diameter portion

$$f = \frac{88,356 \times 9.5 \times 32}{\pi \times 7.25^3} = 22,400 \text{ lb. per sq. in.}$$

At end of  $6\frac{1}{2}$  in. diameter portion.

$$f = \frac{88,356 \times 3.75 \times 32}{\pi \times 6.5^3} = 12,250 \text{ lb. per sq. in.}$$

The stresses throughout this design are too high with the exception of that at the  $6\frac{1}{2}$  in. diameter portion of pin but even this diameter is insufficient to keep the limiting bearing pressure of rod brass within 1,600-1,700 lb. per sq. in. of projected area.

The design is unsuitable for a 25 in. cylinder at 180 lb. steam pressure.

Suitable diameters would be  $8\frac{1}{4}$ , 8,  $7\frac{1}{2}$ , instead of  $7\frac{1}{2}$ ,  $7\frac{1}{4}$ ,  $6\frac{1}{2}$ , as given.

A useful expression for relating "fit allowance" on pin and maximum stress allowed on hub is

$$\frac{x}{d} = \frac{f}{E} \left\{ \left( \frac{m-1}{m} + \frac{1}{m'} \times \frac{E}{E'} \right) \frac{r_1^2 - r_2^2}{r_1^2 + r_2^2} + \frac{E}{E'} \right\} \text{.....(e)}$$

where  $x$  = allowance for fit on pin in inches  
 $d$  = bore of hub in inches  
 $f$  = stress produced, lb. per sq. in.  
 $E$  = modulus of elasticity of pin material  
 $E'$  = modulus of elasticity of hub material  
 $r_1$  = external radius of hub  
 $r_2$  = internal radius of hub  
 $m$  = Poisson's ratio for pin material  
 $m'$  = Poisson's ratio for hub material

For similar material  $E' = E$  and  $m = m_1$ .

The values for cast and forged steel are sufficiently close

to be taken as equal: namely, 30,000,000 lb. per sq. in. for "E" and 4 for "m." Then equation above becomes

$$\frac{x}{d} = \frac{f}{E} \left( \frac{r_1^2 - r_2^2}{r_1^2 + r_2^2} + 1 \right) \dots \dots \dots (f)$$

A suitable allowance for the pin given may be found from above, taking say a maximum stress of 12,800 lb. per sq. in. on hub as previously found.

$$\frac{x}{7.5} = \frac{12,800}{30,000,000} \left( \frac{6.75^2 - 3.75^2}{6.75^2 + 3.75^2} + 1 \right)$$

$$x = \frac{128}{300,000} \times 1.528 \times 7.5$$

$$\text{Allowance} = .0049 \text{ in.}$$

This would require a pressing force of 140 tons. From Equation (f) allowance, stress or hub thickness may be found by giving values to any two. It is interesting to note that by increasing the value for " $r_1$ "; that is, the outside radius of hub while still retaining a fixed value for  $x$ , the allowance, not only is the hub stress reduced but what is of greater usefulness the holding power is increased and too this will increase much more rapidly for increments of hub thickness than the stress on material decreases. Therefore, security of pin calls for thick hubs quite apart from considerations of strength.

The expression relating fit allowance and gripping pressure per sq. in. is given thus

$$\frac{x}{d} = \frac{p_1}{E} \left\{ \frac{m-1}{m} + \frac{E}{E'} \frac{1}{m'} + \frac{E}{E'} \times \left( \frac{r_2^2 + r_1^2}{r_2^2 - r_1^2} \right) \right\}$$

When hub and pin are of similar material this becomes

$$\frac{x}{d} = \frac{p_1}{E} \left( 2 \times \frac{r_2^2 + r_1^2}{r_2^2 - r_1^2} \right) \quad \text{or}$$

$$p_1 = \frac{x E \times (r_2^2 - r_1^2)}{2 d \times (r_2^2 + r_1^2)}$$

$$p_1 = \text{gripping pressure per sq. in.}$$

For derivation of the above formulæ and a full discussion of the stresses produced by forced fits the reader is referred to Morley's "Strength of Materials" (Longman Green & Co.).

## Design of Crank-Pin and Crank-Pin Hub

### Criticism of Solution in June Issue

By H. J. Coventry

The following comments are offered in regard to the answer published in the June issue of the problem given in the April issue.

The assumption of one or two per cent smaller diameter of bore than pin is unwarranted seeing that the allowance is a function of the driving force which is given as 140 tons. Also the practice of coning the pin is open to question and is by no means considered good practice as the fit is not

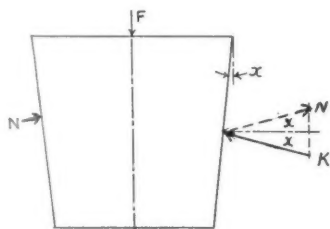


Fig. 1

as tight as a parallel pin and bore while if the pin should creep at all it speedily comes loose.

However, waiving these points and assuming a taper of 1/100, we get an angle of slope to center line of 1/200, or  $X$  is an angle whose tangent is 0.005. Therefore,  $X = 17'$ ,

not  $35'$ . The force  $F$  is balanced by the two forces  $N$  and  $K$  normal to the surface of the pin.

By the triangle of forces (Fig. 1),

$$K = N \text{ and } N = \frac{F}{2 \sin X}$$

The friction angle must be added to  $X$  and taking the coefficient of friction at .23 gives an angle of 13 degrees so that

$$N = \frac{F}{2 \sin (13^\circ 17')} = \frac{140}{2 \times .229} = 305 \text{ tons}$$

$$\text{Pressure per sq. in.} = \frac{305}{0.5 \times 7 \times 7\frac{1}{2} \times \pi} = 3.7 \text{ tons per sq. in.}$$

This is quite a different result from that of your correspondent who has apparently neglected the coefficient of friction, resolved the force wrongly and overlooked the fact that across any diameter we have force  $N$  acting on half the surface area while  $K$  acts on the other half.

Fibre stress in hub

$$T = 3.7 \left( \frac{R^2 + r^2}{R^2 - r^2} \right) = 7 \text{ tons}$$

Maximum allowable forcing pressure

This is correctly calculated although there is evidently a numerical error as it is stated that "the safe working load = 75,000 lb\* =  $7\frac{1}{2}$  tons. A limit stress of 13 tons would be about right for 65,000 lb. cast steel and substituting this in above gives

$$13 = p \left( \frac{R^2 + r^2}{R^2 - r^2} \right) \quad p = \frac{13}{1.89}$$

$$p = 6.87 \text{ tons per sq. in.}$$

$$\text{Total pressure} = 6.87 \times 165 = 1,135 \text{ tons}$$

$$\text{Pressing force } F = 1,135 \times .229 = 260 \text{ tons}$$

Your correspondent gives only the total surface pressure instead of maximum driving force required without bursting hub as the question calls for.

The load assumptions are not warranted by practice; for instance, it would be a very poor engine which in full gear had a steam chest drop of 20 lb. per sq. in. pressure and a back pressure of 20 lb. per sq. in. Twenty pounds per sq. in. *absolute* might be nearer the mark.

It is not usual in cylinder and motion design to take anything less than full boiler pressure acting on the total area of the piston, thus giving the piston thrust and maximum force acting on the crank-pin. It is quite true that thrust along the connecting rod is higher than that on the piston when the connecting rod is at an angle to the centre line but for locomotive rods which are usually long compared to the stroke, the amount is small and is amply covered by taking the maximum piston thrust.

$$\text{Piston thrust} = 180 \times 25^2 \times \frac{\pi}{4} = 88,356 \text{ lb. or } 44.178 \text{ tons.}$$

Strength of pins

The crank pin is a cantilever and the maximum bending moment

$$M = Wl \text{ where } l = 9\frac{3}{4} \text{ in.}$$

$$W = 44.178 \text{ tons}$$

The section modulus =  $0.098d^3$  and

$$Wl = .098d^3f \text{ where } f = \text{stress, say } 8\frac{1}{2} \text{ tons}$$

The maximum bending moment occurs at the face of the hub which is  $9\frac{3}{4}$  in. from the center of the load, not  $7\frac{1}{2}$  in.

$$44.178 \times 9.75 = .098 \times 8.5 \times d^3$$

$$d = \sqrt[3]{\frac{44.178 \times 9.75}{.098 \times 8.5}} = 8 \text{ in.}$$

A  $7\frac{1}{2}$  in. diameter pin is, therefore, inadequate. The strength at the other diameters may be found similarly using appropriate  $l$ . The other diameters are also too highly stressed except the  $6\frac{1}{2}$  in. diameter portion, but this has insufficient bearing area to limit pressure to 1,700 lb. per sq. in. projected area, the actual bearing pressure being

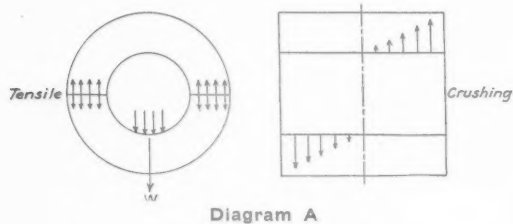
\*This is a typographical error and should have read 15,000 lb.—EDITOR.

1,815 lb. per sq. in. Locomotive driving wheels make from 300 to 400 r. p. m. so that an empirical formula for bearing pressure based on 150 r. p. m. is unsuitable.

#### Stress in hub due to load $W$ and pressure of pin

The moment  $R_1$  and  $R_2$  surely act at planes A'A and C'C which can be easily understood if the pin is imagined to be loose in the bore.

$R_1$  and  $R_2$  are equal and opposite, tending to tear the boss



across a diameter and therefore putting the metal in tension. There is, of course, a crushing influence starting at a maximum on the bottom of plane A'A at point A in Fig. 4 decreasing to 0 at center line B'B and similarly on section from B' to C', but it will be found that the boss is stronger against crushing than in tension across the diameter. This might be illustrated by Diagram A.

$$R_1 = W \times \frac{9.75}{7}$$

$$R_2 = W \times \frac{9.75}{7}$$

$$W = \frac{9.75W}{7} = 1.393W \text{ at plane C'C and}$$

$$W + w = 2.393W \text{ at plane A'A}$$

$$= 105.5 \text{ tons}$$

$$\text{Crushing stress} = \frac{105.5}{D \times \frac{1}{2}} \text{ not } \frac{105.5}{\frac{1}{4} \pi D^2}$$

$$= 4.025 \text{ tons per sq. in.}$$

$$\text{Tensile stress} = \frac{105}{7 \times 2 \times 3} = 2.5 \text{ tons per sq. in.}$$

$$\text{Total tensile stress in hub due to load } W \text{ and pressing in of pin} \\ = 2.5 + 7 = 9.5 \text{ tons per sq. in.} \\ \text{or } 19,000 \text{ lb. per sq. in.}$$

As the compression reaction and the tensile stress act on planes at right angles to one another the tension never relieves the compression. This may be seen better by taking an elementary area at the bottom of the bore (see Diagram B). This will have a compressive stress of 4.025 tons per sq. in.

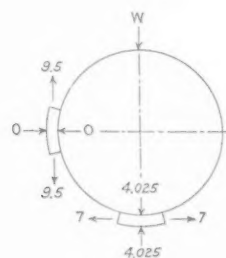


Diagram B

and at right angles to it a tensile stress of 7 tons, or that due to forcing in pin only. A similar element at right angles to above will have a tensile stress of 9.5 tons per sq. in. and no compression at all. The stresses will, therefore, fluctuate from 7 to 9.5 tons per sq. in. tension and from 0 to 4.025 tons per sq. in. compression.

All these stresses and general proportions of the hub and pin indicate that it is entirely too small for a 25 in. cylinder working at 180 lb. per sq. in.

If, as is good practice, the pin is made parallel, the expression for normal pressure becomes

$$N = \frac{F}{2 \sin X} \text{ as before, but as angle } X \text{ is now } 0'$$

$$N = \frac{F}{2 \times 0} = \frac{F}{0} = \text{Infinity}$$

$$\text{and } F = 0$$

This result is quite logical as it merely means that if  $F$  is a definite quantity, then  $N$  may be anything definite up to infinity, depending on amount of increase of pin diameter. While if no driving force is required, no normal pressure is produced; that is, the pin becomes a sliding fit.

This is given to illustrate the writer's contention that the terms of the problem were not adhered to by Mr. Montangie in assuming a taper pin. If the pin is parallel, the above expression will not be soluble and this method would not apply.

## AIR BRAKE CORNER

### I. C. C. Power Brake Hearing to Be Resumed in July

DURING the second week of the hearing in May, Spencer G. Neal, chief engineer, Automatic Straight Air Brake Company, was on the stand for two days. He was followed by J. E. Grant, special agent of the Bureau of Explosives. Other witnesses called by the Automatic Straight Air Brake Company were H. B. McFarland and George L. Fowler, consulting engineers, and A. J. Schuyler, general car inspector, Virginian Railway.

The first two witnesses presented by the Westinghouse Air Brake Company were W. S. Bartholemew, vice-president, and George W. Wildin, general manager. They were followed by T. W. Dow, Erie; J. F. Gannon, New York Central; P. J. Langan, Delaware, Lackawanna & Western; and George E. Terwilliger, New York, New Haven & Hartford. The Westinghouse Air Brake side of the case was closed with evidence by Prof. S. W. Dudley, Yale University (formerly chief engineer W. A. B. Co.), and C. C. Farmer, director of engineering, W. A. B. Co. The only witness for the New York Air Brake Company was B. J. Minnier, local manager.

Others who appeared were J. H. Phillips, who described a metallic hose connector, and W. H. Sauvage, who requested permission to describe his air brake system and also the automatic slack adjuster made by the Gould Coupler Company.

The hearing was adjourned on Monday night, May 29, subject to call. Notice has since been sent out reconvening the hearing at Washington on July 17.

### Jumping Action of Air Compressor

**Question.**—Sometime ago I had an engine terminating here which was equipped with an 8½-in. cross-compound pump. Just about the time the pressure was pumped up to where it affected the governor, the high pressure steam piston would commence to jump up and down in such rapid succession that it would shake the whole engine. I at first concluded that as the governor was closing, the steam pressure around the reversing valve was not sufficient to hold the valve seated and the weight of the valve and reversing stem would cause the valve to drop and reverse the pump before the piston had time to reach the end of its stroke, in fact the length of the strokes did not appear to be more than ¼ in. With the idea of

overcoming the trouble I made a flat spring of proper length and placed it between the shoulders in the top of the reversing rod and back of the reversing valve, so that the reversing valve would be forced hard against the seat at all times, but the modification was fruitless as it did not overcome the trouble. Finally after about 30 days the action was less frequent and gradually ceased to exist. Can you advise what the trouble was?—F. N.

*Answer.*—This question is somewhat difficult to answer for while a good description of the action has been given, there are several things that might have brought it about. It is possible that a bend in the valve rod caused it to rub against the reversing valve plate on the steam piston and thus brought about a shifting of the reversing valve and a reversal of the piston movement before the reversing valve plate came in contact with the shoulder or button on the

valve rod. This unusual friction may have existed only for a short period and ceased after a slight wear occurred thus resulting in the trouble gradually disappearing as described.

(If any of our readers have observed similar action, we would be pleased to learn the cause and how it was corrected. —Editor.)

### Answers to Questions in June Issue

Several answers have been sent in to the five questions given in the *Railway Mechanical Engineer* for June 1922. As some were received just before this issue was published, it was decided best not to print the answers until the August number. If any other readers desire to send in answers, they should do so promptly so that they will reach the New York office before July 15.—Editor.

## WHAT OUR READERS THINK

### Vacuum Brake Tests on English Goods Trains

DERBY AND DONCASTER, England.

TO THE EDITOR:

In the article which appeared in your April number on the tests of vacuum brakes described in our paper before the Institution of Civil Engineers, it is pointed out that the retarding effect of the vacuum brake compares unfavorably with tests of the Westinghouse brake made in America as far back as 1887.

We wish to point out that the tests on the Great Northern railway were in no way intended to ascertain the shortest distance in which a freight train fitted with vacuum brakes could be stopped; the object of the tests was to ascertain whether satisfactory stops with existing equipment could be made with, what are in this country, long freight trains consisting of up to 100 wagons. The wagons were not fitted with special apparatus to give the highest braking effect and the results, therefore, should not be compared with the Westinghouse brake as regards stopping distance.

As a matter of fact, tests made in this country and also on the continent, indicate that long freight trains fitted with the vacuum brake stop in as short a distance as trains fitted with the Westinghouse brake.

(SIR) HENRY FOWLER.

Chief Mechanical Engineer, Midland Railway.

H. N. GRESLEY.

Locomotive Engineer, Great Northern Railway.

### Superheated Steam for Locomotive Auxiliaries

STOUC CITY, IOWA

TO THE EDITOR:

It has been stated that 22 lb. of coal per hour is required to run a headlight dynamo. Tests have shown that superheated steam is some 25 per cent more economical than saturated steam. Such being the case, if superheated steam was used for this purpose, there would be realized a saving of one-fourth of 22 lb., or 5½ lb. per hour. On a typical main line division of a middle western railroad there are four scheduled night runs. It takes about 10 hr. for each run, or 40 hr. for the four runs. Forty times 22 lb. per hour equals 880 lb. of coal per night and 880 lb. times 30 days equals 26,400 lb. per month—approximately 13 tons of coal

per month on four runs at \$5 per ton equals \$65 per month for the headlight dynamo alone. If superheated steam were used, it would give a saving of \$16.25 per month for 12 months, or \$195 per year for these four runs. Assuming that the 18 divisions of the system had four night freight runs each, this would equal \$3,510 (\$195 times 18) saving per year on 72 freight runs for the headlight dynamo alone.

It takes about 200 lb. of coal per hour to run a train dynamo and the dynamo is run in summer as well as winter months. There are eight trains which run a dynamo from Chicago to Omaha. Assuming that this is two-thirds of the dynamo trains on the system, there would be approximately 12 trains times 12—assuming the schedule to be 12 hrs.—or 144 hrs. at 200 lb. per hour, or 28,800 lb. of coal per day; 864,000 lb. per month and 10,368,000 lb. per year for the train dynamos. In tons this would be approximately 5,134 tons at \$5 per ton, or \$25,670 per year. If we substituted superheated steam for the train dynamos, it would give one-fourth saving in coal alone, which would amount to \$6,417 per year.

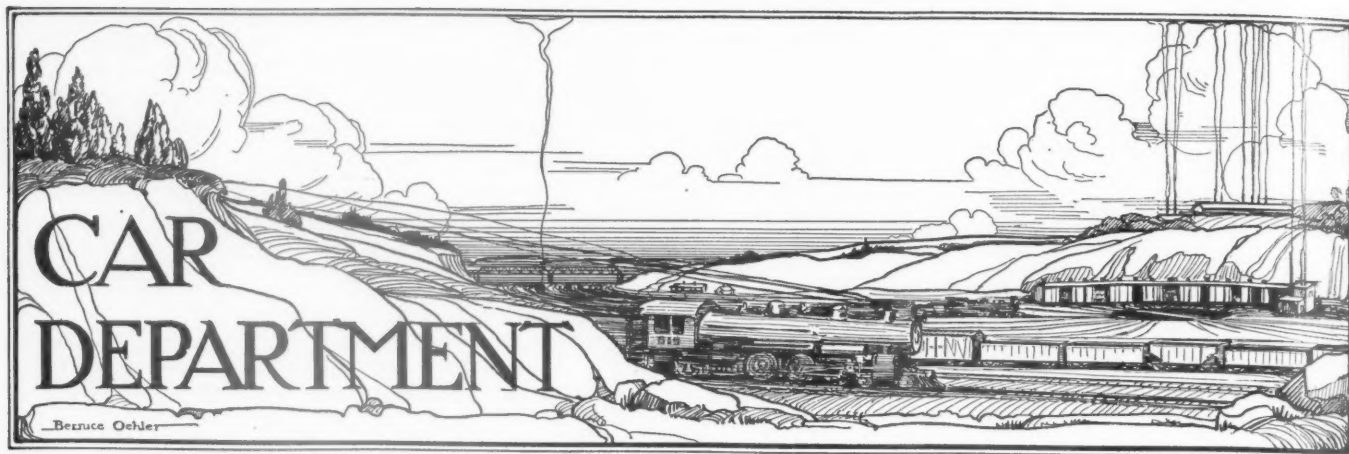
For the headlight dynamo we can take the same number of passenger trains. Assuming that this is all the passenger trains that use a headlight dynamo, 144 hrs. times 5½ lb. per hour equals approximately 800 lb. for the trains per day; 292,000 lb. or 146 tons per year at \$5 per ton, or \$730.

The foregoing has shown a saving of \$6,417 for train dynamos, \$730 for passenger locomotive headlight dynamos and \$3,510 for freight locomotive headlight dynamos or a total of \$10,657 per year on one large trunk line.

It has furthermore been stated by good authority that it cost the railroads of the United States 6,000,000 tons of coal to supply the leaks in the air brake train line alone. Assuming an equal amount of air is required to charge the brake for applications, etc., the air pumps would use 12,000,000 tons per year. This at \$5 per ton would be \$60,000,000 per year, and one-fourth saved by the application of superheated steam would be \$15,000,000 per year on the steam for air pumps.

A study of the figures given presents a strong argument for the use of superheated steam for dynamos, air pumps and other locomotive auxiliaries which should not be overlooked in attempts to reduce operating costs.

M. M. CROWLEY.



## Some Notes on Railway Refrigerator Cars\*

Survey of Existing Equipment; Efficiency of  
Insulation; Special Systems of Refrigeration

By W. H. Winterrowd  
Chief Mechanical Engineer, Canadian Pacific

IN an endeavor to sense the trend of refrigerator-car design, proportions, and construction, the writer addressed and inquiry to a number of railways and private-car owners. A comparison of the most interesting returns is shown in Table 1, and makes a very interesting study, although in any consideration of this table the fact must not be overlooked that possibly some of the railroads or owners, if building equipment today, might modify their designs.

Every road or owner represented owns at least one thousand cars. As far as possible the cars shown were chosen from quantities built in comparatively recent years. Many of the old timers, really not refrigerator cars at all, were omitted. Even so, some of the cars built in recent years provoke question.

Another point is that during the past three years car building or rebuilding has been at a minimum. Even so, it is of great interest to note that many of the cars built within this period, or being designed or constructed today, embody in great measure those principles which make for an efficient and economical unit.

### Types of Cars and Ice Containers

Generally speaking the cars can be divided into two types: one, equipped with brine tanks and generally used for carrying meats; the other, equipped with bunkers, and used principally for carrying commodities such as eggs, butter, vegetables and fruit.

In connection with this distinction, based on ice containers, it is interesting to note that Dr. Pennington has stated that a car of the basket-bunker type, such as the U. S. Railway Administration Standard, will carry meat hung from rails quite as successfully as a car built especially for meat. The statement is also made that there is not visible in practical results the advantages supposed to accrue from the retention of the brine, provided coarse rock salt is placed on top of the ice in the bunker and so forced to bore its way through the whole mass before finding an exit.

But there is a very important problem in this connection

\*Conclusion of abstract of a paper presented before the American Society of Mechanical Engineers at New York, May 16. The first part of the paper was abstracted in the June issue, page 339.

that must not be overlooked if salt is to be used with ice in a basket bunker, and that is the method of disposing of the brine. The subject of brine drip is one that has received a great deal of attention by railway engineers. It is common knowledge that if brine falls on journal boxes, side frames, arch bars or other truck parts, as well as upon rails, tie plates, bridge members, etc., the resulting damage is great and a factor involving heavy maintenance cost.

The subject is so important that the American Railway Association interchange rules specify that after July 1, 1922, no car carrying products which require for their refrigeration the use of ice and salt and which are equipped with brine tanks, will be accepted in interchange unless provided with a suitable device for retaining the brine between the icing stations. If salt is to be used with ice in basket bunkers, a practical and economical arrangement is necessary to retain the brine so that it can be disposed of between icing stations.

The data submitted do not show any car of the basket bunker type equipped with overhead meat racks. They show that cars built for carrying meats and products requiring a low temperature are equipped with brine tanks.

Twenty-seven railroads and owners are represented in Table 1. Out of this number the principal cars of 16 are equipped with bunkers, and the remainder are equipped with brine tanks. Out of the 16, 11 or practically 69 per cent are of the basket type; the remaining five, or approximately 31 per cent, are of the box type. The majority of the cars recently built, or now under construction, are equipped with the basket type of bunker. The demand for refrigeration and the special-service car, as well as greater efficiency of the permanent basket type, appear to be decreasing the demand for the collapsible bunker.

Another distinction that prevails and will prevail as long as cars are built for some particular service is the difference in construction due to the commodity to be transported.

In meat cars the lading is hung on hooks suspended from a meat rack placed just below the ceiling. This rack generally consists of stringers and cross bars supported by the roof and walls of the car. In a car of this type it is necessary to make the framing heavier so that in addition to its

other functions, it will adequately support the weight of the lading. A meat rack and hook installation was illustrated in Fig. 4 (June issue, page 340). Very often additional lading is stowed or placed on the floor racks beneath the suspended load, in order to obtain the maximum carrying capacity of the car.

**Bulkheads.**—The majority of the cars tabulated are equipped with solid bulkheads. These are either built into place or are hinged from the walls or ceiling so that they can be swung open.

A few cars are equipped with the syphon system, in which the bulkhead consists of a framework holding a series of galvanized iron louvres supposed to direct the air back and down into the bunkers. The theory is that air entering the bunker over the top of the bulkhead becomes chilled, and in its downward motion creates a suction or siphoning effect which draws air from the body of the car into the bunker through the openings in the bulkhead. Although this system is on some cars of fairly recent origin it is significant that many railroads or owners who used it

space the bulkhead is brought right down to the level of the floor rack. On the bottom of this bulkhead a canvas strip is fastened to prevent cold air passing out above the racks. The cars with the very large openings at both bottom and top of bulkheads are generally used for meat shipments.

The majority of the cars have a bottom opening of from 9 to 15 $\frac{3}{4}$  in. The average is about 12 in. As the floor racks on these cars average about 4 $\frac{1}{2}$  to 5 in. in height it can be seen that the cold air has access to the body of the car above the rack as well as through the space beneath it.

The writer has endeavored to ascertain if there is any relation between the size of the openings above and below the bulkhead and the velocity of the air in circulation, but inquiry has not produced anything definite. There is some unanimity of opinion, however, in favor of the design in which there is an opening of from 2 to 7 in. above the floor racks. If there are any data on this subject they should be of considerable interest, but if no definite information exists the matter appears to be one worthy of careful investigation. It is evident that any improvement in circulation would help to bring about more uniform temperatures, an obvious benefit.

In the matter of efficient refrigeration the distance between bulkheads is an important one. The tabulation shows that this varies between 28 ft. 8 in. and 38 ft. 10 in. The general trend is between 32 and 34 ft. On the latest cars the spacing is approximately 33 ft., or slightly greater. The size of the standard egg crate has been a large factor in the establishment of the exact dimension.

Difficulty in obtaining proper temperatures at the center and top of the lading has been responsible for the thought that longer cars and less deep loading would bring better results. Longer cars have been demanded also as the result of a desire to increase their capacity.

The principle has been emphasized that heat transmission varies directly as the number of square feet of surface enclosing the car space. A study of some of the long cars indicates that this principle has not been followed closely in determining the kind and amount of insulation.

**Floor Racks.**—Space between the top of the floor rack and the floor of the car averages between 4 $\frac{1}{2}$  and 5 in. The majority of the modern cars are equipped with these racks, but an examination of the tabulation would indicate that their importance is not fully recognized. This fact is borne out by an examination of hundreds of refrigerator cars at a fruit-and-produce-distributing station. Many of the cars with long slats or runners fastened to the floor are of such construction and equipped with such types of bulkheads that floor racks could be applied easily and cheaply.

#### Car Construction and Maintenance

An impression seems to prevail that the life of a railway refrigerator car is about 6 to 8 years. In 1919 a committee of the Mechanical Section of the American Railway Association reported that the average life of railroad-owned wooden refrigerator cars dismantled was 17.1 years, and of private-line wooden refrigerator cars dismantled, 21.9 years, making the average life for all wooden refrigerator cars dismantled 19.4 years. It was also stated that the average life of railroad-owned wooden refrigerator cars was largely affected by two lines reporting the dismantling of a large number of cars of an average life of only 15 years; by excluding these two lots of cars, the average life for railroad-owned wooden refrigerator cars was 21.3 years, and for private-line-owned cars 21.9 years.

The life of refrigerator cars equipped with steel underframes or steel framing and superstructure is a matter upon which there are little data, because such cars are comparatively modern. There seem to be no reasons, however, barring those of possible evolution, why such cars should not

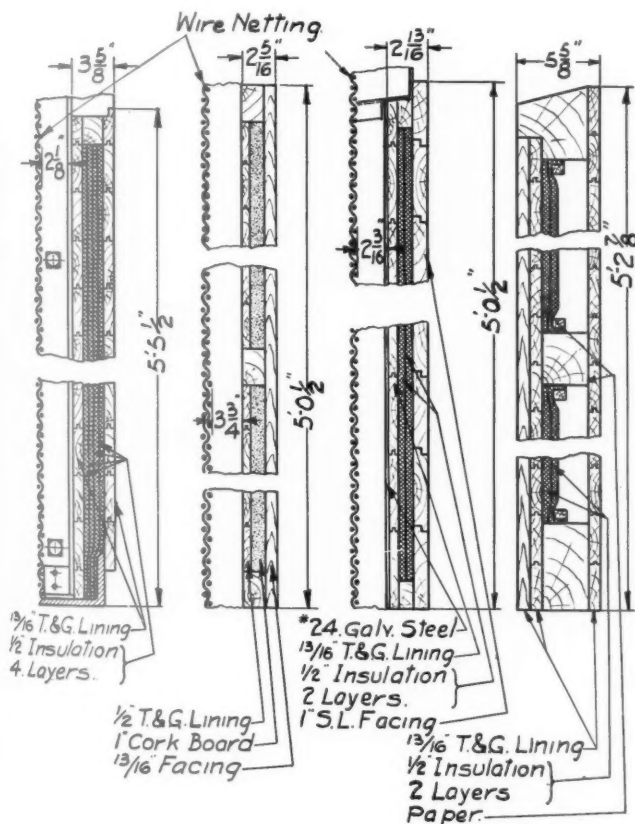


Fig. 5—Typical Cross Sections of Bulkheads

on their older cars have abandoned it in favor of the solid bulkhead.

The prevailing trend of construction indicates a recognition of the value of solid and insulated bulkheads. The general trend seems to be to use two layers of  $\frac{1}{2}$ -in. hair felt between two walls of 13/16-in. matched-and-dressed-wood lining. An interesting exception, and on a quite recent car, is the use of one layer of 1-in. cork insulation. Some bulkheads are constructed of two walls with a few layers of waterproof paper between them. Occasionally an air space is contained between the walls. In one instance, in addition to a dead-air space, two layers of  $\frac{1}{2}$ -in. hair felt are provided. Some cross sections of bulkheads are shown in Fig. 5.

**Space Below Bulkheads.**—The space between the bottom of the bulkhead and the car floor varies considerably, ranging from 7 in. to 2 ft. 7 in. On the car with the 7-in.

TABLE 1—DETAILS OF CONSTRUCTION OF REFRIGERATOR CARS (SEE FIG. A FOR KEY TO DIMENSIONS)

Road or owner	Over striking castings, ft.-in.	A	B	C	D	E	F	G	H	K	L	Floors				Sides				Roof				Type of underframe	Road or owner																																																																																																																																																																																																																																																																																																																																																																																															
												Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.			Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	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Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	Type of bulkhead	Height opening above bulkhead	Height opening below bulkhead	Height of floor rack	Door height, ft.-in.	Door width, ft.-in.	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Fig. 15

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have a long life and require little for maintenance by reason of their better design and construction.

It is not difficult to appreciate the causes responsible for the high cost of maintenance of old wooden cars; the refrigerator type does not stand alone in this class. But in addition to more severe traffic conditions, this type of car has required attention on account of the difficulty in keeping moisture away from the insulation as well as from the wooden framing and flooring. If the insulation becomes broken, wet, or sags so that air can circulate around it, the car rapidly loses its efficiency. Table 1, and the cross sec-

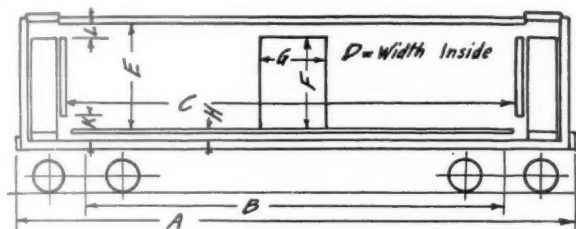


Fig. A—Diagram of Dimensions Shown in Table 1

tions in Figs. 6 to 14 inclusive, give a general idea of some types of cars, and what has been done to improve design and construction. Figs. 12 and 13 represent cars of relatively low efficiency. The others show more modern cars and indicate the more recent trend in the matter of improved insulation and general construction.

The cross sections really speak for themselves, but a brief discussion under the separate headings floors, walls and roofs will be of some interest.

**Floors.**—The chief problem in floor construction is to

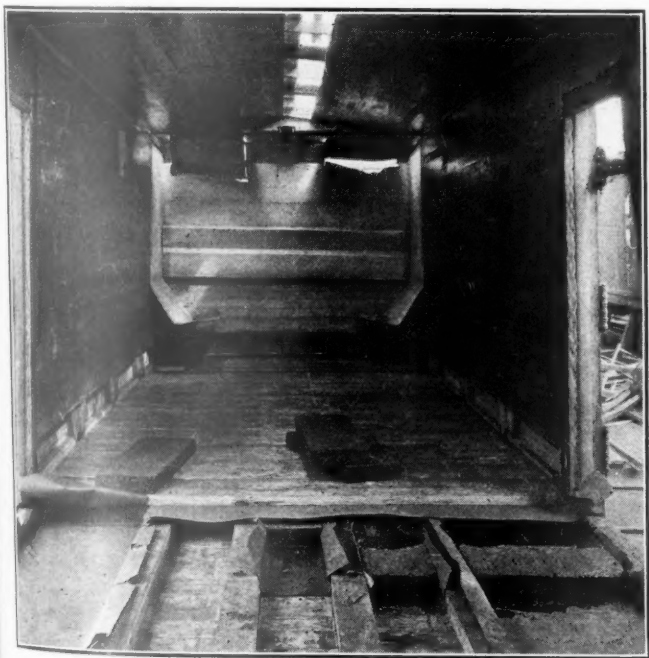


Fig. 15—Method of Applying Insulation and Waterproofing in Floor

make the structure waterproof, as well as a good insulator. Moisture and water finding its way through the floor or along the floor boards into the walls of the car, have been responsible for much trouble and expense.

The insulating value of all materials that absorb moisture is greatly decreased when water is absorbed. In addition, water causes most of the insulating materials popular in refrigerator construction to become mushy and sag or drop out of place. It also causes wood floors, lining and framing

to decay and weaken, thereby making it more difficult to keep the general structure tight.

Nearly all the modern or at least recently built floors employ a construction involving cork as an insulating material. With two exceptions, shown in Figs. 8 and 9, the cork is applied in one layer. To keep moisture away from the cork various waterproofing compounds or waterproof materials are used. Fig. 15 shows a photograph of the floor and manner of applying insulation.

The one exception to this general trend is shown in Fig. 14, where the insulation consists of four massed layers of  $\frac{1}{2}$ -in. hair felt. Moisture is kept away from the top of the insulation by means of two layers of floor boards between which is laid a layer of waterproofing compound. The surface of the top floor is covered with a layer of waterproofing compound into the surface of which sand has been rolled.

Figs. 12 and 13 show a floor insulation with intervening dead-air spaces. In past years it was the opinion that this type of construction gave the highest insulation value in walls and roofs as well as in floors. More recent opinion differs because experience has shown that unless unusual methods of construction or maintenance are used, it is very difficult to keep the air spaces tight. To be insulators, they must be dead-air spaces; once circulation starts their efficiency is destroyed.

It has been intimated that in some cases cork as a floor insulator has not been entirely satisfactory because in time it becomes brittle and crumbles. Specific information on this subject would be very valuable, as it would indicate whether the trouble was inherent or due to some particular method of construction.

**Walls.**—In connection with a waterproof structure, it is interesting to note the various methods employed at the junction of the floor and side walls to keep water from getting past the lining and into the insulation. This point has been a source of great trouble. Some particularly interesting methods of construction at this point are shown in Figs. 11 and 14.

An exceedingly interesting example of waterproof construction is contained in some all-steel refrigerator cars designed by W. F. Keisel, Jr., Mechanical Engineer of the Pennsylvania Railroad.\*

An interesting feature in connection with these cars is the fact that the body of the car consists of an all-steel container placed within an outer container, the space between the walls being filled with insulation. At the floor, the sections of the inner container are welded together, thus making the floor practically one piece and water-tight and thereby affording maximum protection to the insulation.

Inspection of the various cross sections indicates a general trend toward massing wall insulation and eliminating air spaces between the layers of insulation. As a rule the insulation is applied in a continuous strip from door post to door post. The advantage of applying insulation in this way lies in the fact that a continuous or unbroken surface presents no joints or openings through which air can pass or circulate. It has been the experience that where insulation is applied in sections, unusual construction is required to prevent eventual air circulation. Wall insulation is rarely less than 2 in. thick on the most recent cars. In some cases this insulation is applied in two massed layers. In one case the single layer is 2-in. thick. In the majority of cases four massed layers of  $\frac{1}{2}$ -in. insulation are used.

The construction employed by the U. S. Railway Administration is indicated in Fig. 6 and shows the insulating material massed beneath the outside sheathing. Air space is provided between the inner lining and the blind lining. This construction was advocated as a method of preventing dam-

\*See *Railway Mechanical Engineer* for March 1917, p. 133.

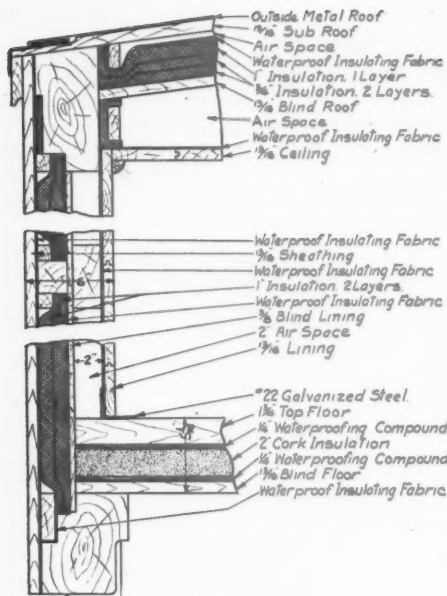


Fig. 6

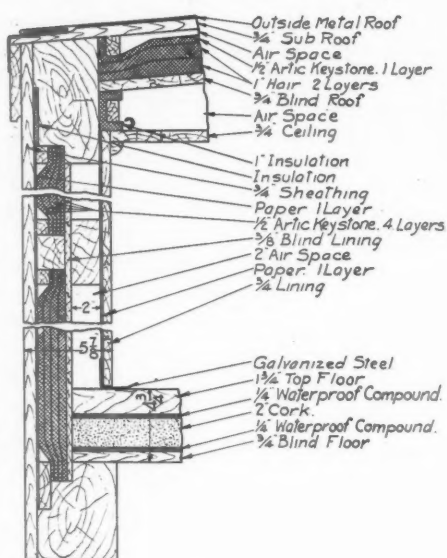


Fig. 7

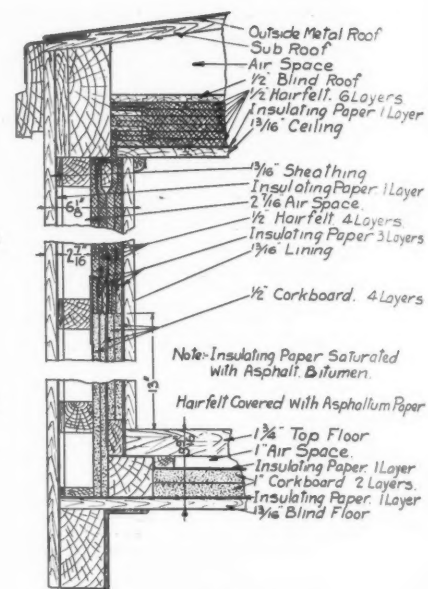


Fig. 8

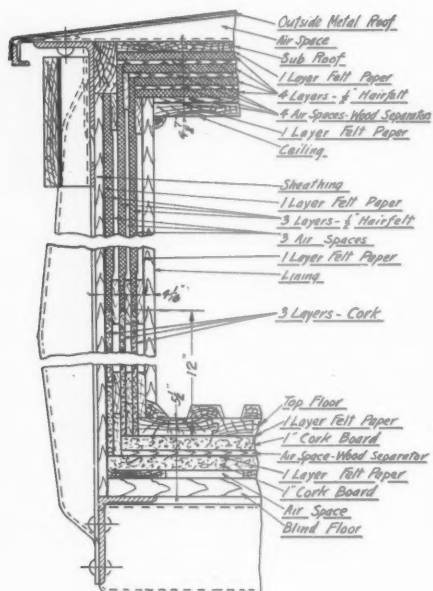


Fig. 9

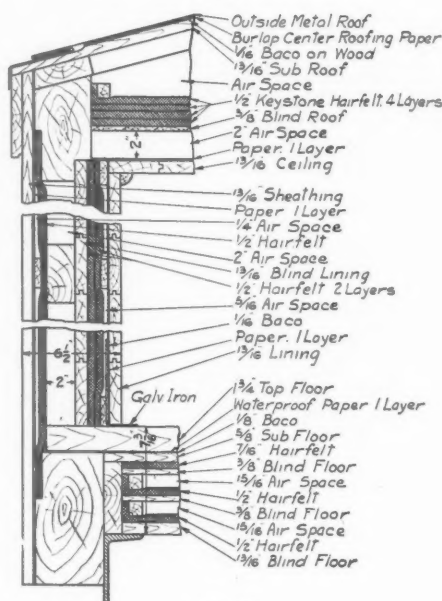


Fig. 10

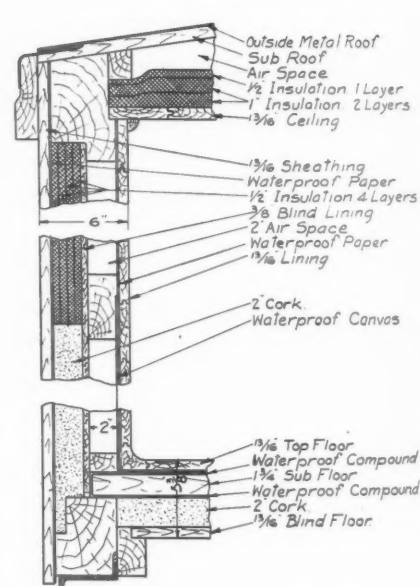


Fig. 11

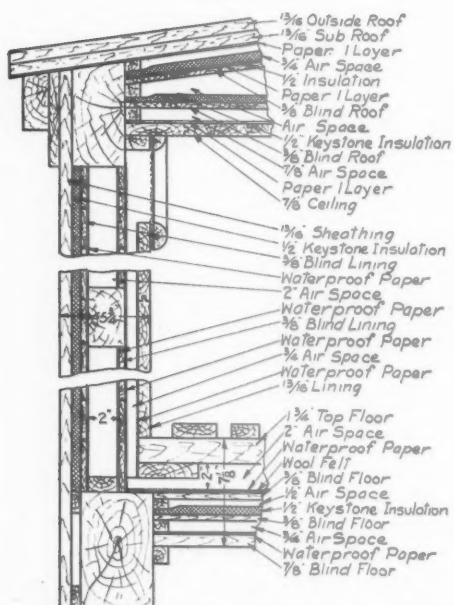


Fig. 12

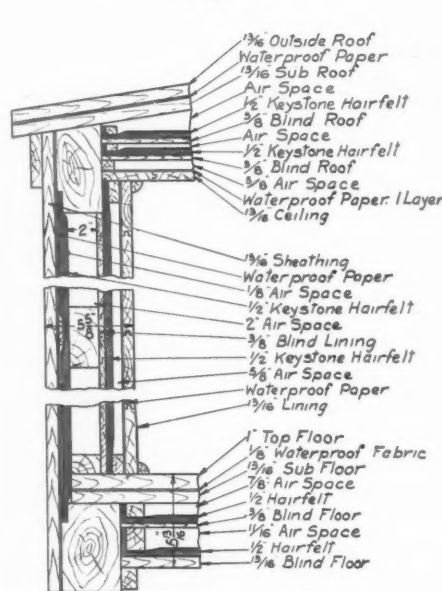


Fig. 13

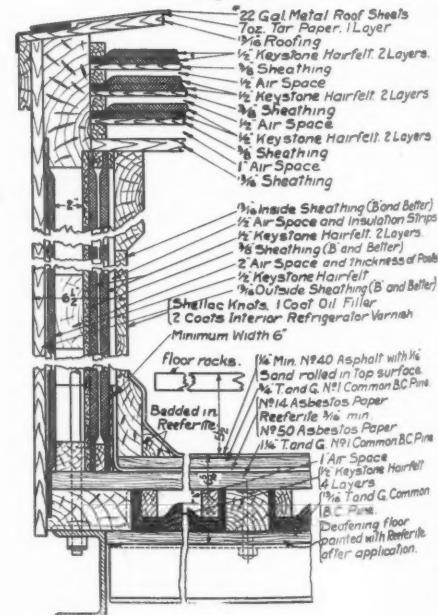


Fig. 14

Cross Sections Through Bodies of Typical Refrigerator Cars

age to the insulation should nails be driven through the inside lining.

A great many cars are insulated in this way, but there are some interesting exceptions, one of which is shown in Fig. 8. The advantage claimed for such construction is that if a car becomes cornered or damaged to such an extent that sheathing is cut or broken, the insulation stands a much better chance of remaining intact or becoming only slightly damaged, and the lading not subjected to risk caused by loss of cold air. It is also claimed that by the use of properly constructed wood forms or spacers, and by proper loading methods, no necessity should exist for driving nails through the inside lining. A great many railroads are conducting an educational campaign in this connection.

Two interesting wall structures are shown in Figs. 8 and 9. In these figures it will be seen that layers of cork board are used below the insulation, the hair felt starting at a point 13 in. above the level of the floor.

**Roofs.**—The tendency is to apply massed insulation in the

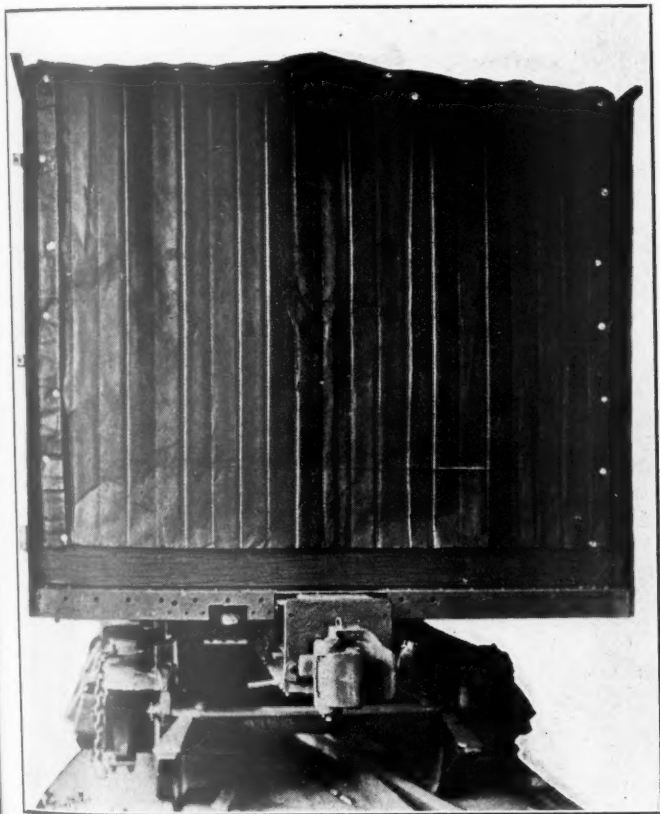


Fig. 16—End View of Pennsylvania All-Steel Refrigerator Car

roofs. As a rule the most modern cars have 2 to 2½ in. of insulation applied in this way. The car shown in Fig. 8 has 3 in. of such insulation.

Some cars are equipped with a carefully designed double-board roof with waterproofing compound between the layers. There are many advocates of this type of roof, but it is interesting to note the number of outside-metal roofs that are applied to cars of this type. The advocates of the outside-metal roof claim a saving in weight and greater protection to the sub-roofs and insulation from moisture, claiming that with proper insulation the metal roof has no effect on the interior temperature of the car.

#### Miscellaneous

**Doors and Hatches.**—Doors and hatches are being made with more insulation and are being strongly and properly constructed so that they will fit the door openings tightly, and not permit any loss of refrigeration due to leakage. In this

connection, any other openings into the car should be so constructed that they can be kept tightly in place and easily maintained. An efficient door-locking device is no small item in keeping doors tight, and thereby maintaining the efficiency of the car.

**Painting.**—Refrigerator cars should be kept well painted in order to preserve all exterior surfaces. This is in the interest of obtaining long life for the car. Metal parts should be given particular attention in this respect.

The writer believes that refrigerator cars should be painted with a light or non-heat absorbing color. Dark colors absorb heat. An inquiry addressed to the owners of white and yellow cars indicated that no specific data existed on the subject, but it was the general belief that the light colors were an advantage in this respect. Accurate information on this subject would be of great interest.

#### Insulation

The previous references to insulation have been very brief, and have referred principally to its use in general car construction. The following paragraphs contain some notes regarding insulating materials.

It has been stated that the function of the insulation is to afford protection to the contents of the car by minimizing heat transmission through the walls, roof, and floor. A good insulator must not only be a poor conductor of heat, but must be a material having the qualifications of reasonable cost, adaptability, durability, light weight, imperviousness to moisture, freedom from odors, and be proof against vermin. In any study of insulating materials for use in railway refrigerator cars, these factors must all be kept in mind.

There are some materials that have a low thermal conductivity, but their other qualifications make them unsuitable for practical use in the type of car under discussion.

A good insulation, but one which adds greatly to the weight of the car is undesirable. In the interest of economical transportation the car should be no heavier than is necessary to obtain the required efficiency and the required strength to insure continuity of service and low cost of maintenance.

A material with low thermal conductivity, but one which is difficult to apply economically, is also undesirable. On the other hand, there may be materials easy to apply but which will not stay in place or which will not retain their insulating value under service conditions; these are equally undesirable.

In addition, the material should be of a kind easily handled as well as easily applied. Materials difficult to handle and difficult to apply add unnecessarily to the first cost of the car, as well as to possible future maintenance.

It seems to be generally conceded that the best insulating materials are those which contain a very great number of minute dead-air cells, or interstices containing dead-air. If these air cells become filled with moisture, the thermal conductivity of the material is increased. This is one of the reasons why it is so important to protect insulation from water, and why it is desirable to use a material highly resistant to moisture.

Some materials when subjected to moisture fall out of place or sag, and if a large air space, or pocket, is not formed, air circulation frequently results, the effect of which greatly decreases the efficiency of the car.

No argument is necessary to indicate the advantage and value of insulating material free from odors and vermin-proof.

**Thermal Conductivity.**—The question of thermal conductivity of various materials and compound structures is one that has been a matter of study and investigation for many years. The greatest part of the information available upon the subject is the result of tedious, exact and difficult experimentation.

The subject of heat transmission through the walls of a

railway refrigerator car is one upon which there is some difference of opinion, this difference dealing largely with variables or factors which have not yet been reduced to absolute terms.

It is not within the scope of this paper to elaborate upon these differences or to enter into a discussion of all the factors involved. The most important of these deal with the effect of air velocity and moisture upon surface transmission, the effect of moisture upon conduction, the effect of radiation as a corrective factor, and the importance of knowing the condition of the general structure in order to determine the value of the so-called dead-air spaces. The bibliography at the end of the paper refers to literature in which these subjects are discussed in some detail.

In calculating heat transmission through a compound wall, it is essential to know the thermal conductivity of the various materials contained in the structure.

TABLE 2—THERMAL CONDUCTIVITY OF INSULATING MATERIALS

Material	Remarks	Thermal conductivity <sup>1</sup>	Density <sup>2</sup>
Air	.....If no heat is transferred by radiation or convection	4.2	0.08
Calorax	.....Fluffy mineral powder	5.3	4.0
Kapok	.....Hollow vegetable fibers, loosely packed	5.7	0.88
Pure wool	.....	5.9	6.9
Pure wool	.....	5.9	6.3
Hair felt	.....Fibers perpendicular to heat flow	5.9	17.0
Pure wool	.....	6.3	5.0
Slag wool	.....Loosely packed	6.3	12.0
Keystone hair	.....Hair felt and other fibers, confined with building paper	6.5	19.0
Mineral wool	.....Loosely packed	6.5	12.0
Corkboard	.....No artificial binder, low density	6.5	6.9
Mineral wool	.....Fibers perpendicular to heat flow	6.9	18.0
Cotton wool	.....Medium packed	7.0	5.0
Pure wool	.....Very loose packing, probably air circulation through material	7.0	2.5
Insulate	.....Pressed wood pulp	7.1	12.0
Mineral wool	.....Firmly packed	7.1	21.0
Lincfelt	.....Vegetable fiber confined with paper, flexible and soft	7.2	11.3
Ground cork	.....Less than $\frac{1}{8}$ in.	7.1	9.4
Corkboard	.....No artificial binder	7.3	9.9
Balsa wood	.....Very light wood, across grain	7.5	7.1
Balsa wood	.....Same sample with 13 per cent waterproofing compounds	8.3	8.0
Flaxlinum	.....Felted vegetable fibers	7.9	11.0
Fibrofelt	.....Felted vegetable fibers	7.9	11.0
Rock cork	.....Mineral wool and binder	7.9	16.0
Balsa wood	.....Across grain, untreated	8.3	7.4
Corkboard	.....With bituminous binder	8.4	16.0
Balsa wood	.....Medium weight wood	9.2	8.8
Sawdust	.....Various	9.7	12.0
Air cell ( $\frac{1}{2}$ -in.)	.....Corrugated asbestos paper, enclosing air spaces	11.0	8.8
Air cell (1-in.)	.....Corrugated asbestos paper, enclosing air spaces	12.0	8.8
Asbestos paper	.....Built up of thin layers	12.0	31.0
Balsa wood	.....Heavy	14.0	20.0
Fire felt sheet	.....Asbestos sheet, coated with cement	14.0	26.0
Fire felt roll	.....Flexible Asbestos sheet	15.0	43.0
Cypress	.....Across grain	16.0	29.0
Asphalt roofing	.....Felt saturated with asphalt	17.0	55.0
White pine	.....Across grain	19.0	32.0
Mahogany	.....Across grain	22.0	34.0
Oak	.....Across grain	24.0	38.0
Maple	.....Across grain	27.0	44.0
Virginia pine	.....Across grain	23.0	34.0

<sup>1</sup>Thermal conductivity in B.t.u. per day (24 hr.) per sq. ft. per deg. Fahr. per in. thickness.

<sup>2</sup>Density, lb. per cu. ft.

The most recent determinations of thermal value of various materials is shown in Table 2, taken from the very interesting paper, *The Thermal Conductivity of Heat Insulators*, by M. S. Van Dusen, in the October, 1920, journal of the American Society of Heating and Ventilating Engineers.

As previously indicated, the value of air space has been a subject of considerable discussion, because there is some question regarding the length of time that the so-called dead-air spaces remain tight and function as true dead-air containers. A great deal has been said in favor of filling air spaces with a light insulating material.

The following calculations have been made in two ways: first by assigning an insulating value to the air space, and second, by eliminating it entirely. Comparative results are shown in Table 3. Laboratory tests show that the resistance of an air space is a direct function of its width up to about 0.6 in., after which the resistance is practically a constant. In the following calculations the value of the thickness in

inches divided by the thermal conductivity per hour per deg. F. for air is used as 1 when the space varies from 0.6 in. to 6 in. in width. For example, the resistance of a  $\frac{3}{8}$ -in. air space would be  $0.375/0.600$  or  $0.625$ .

TABLE 3

Comparison of B.t.u. per sq. ft. per deg. diff. Fahr. per 24 hr. in cars shown in Fig. 6 and Fig. 13.

	Including air space		Excluding air space	
	Fig. 6	Fig. 13	Fig. 6	Fig. 13
Roof	1.702	2.328	1.953	3.12
Wall	2.172	2.80	2.388	3.768
Floor	2.46	2.544	2.46	3.24

To indicate the difference in the efficiency of walls, roofs and floors in cars of different design, the following examples are offered. In the calculations the car cross-sectioned in Fig. 6 is used as an illustration of good construction and relatively high efficiency. The car shown in Fig. 13 is used in comparison in order to show the greater rate of heat transmission or lower efficiency caused by different methods of insulation and construction.

Some slight value can be attributed to such factors as waterproof papers, fabrics and compounds, but for other ordinary practical purposes these values are given but little consideration, and are generally eliminated from the calculation.

In considering the thermal conductivity in sheathing and lining, the thermal conductivity value of Virginia pine is used. Inquiry indicates that the conductivity of this material is practically the same as that of fir or yellow pine.

### Materials and Workmanship

Proper materials are a very important factor in refrigerator-car construction. The right grade of lumber should be used wherever required, and it should be properly dried before being placed in the car. Workmanship should be of the best. Insulation should be handled carefully, care being taken to see that it does not become torn or damaged. Such insulation placed in a car makes a weak link in a possibly otherwise strong chain. Some care in initial construction with attention to these details makes for an efficient car, as well as one that will have a longer life and lower maintenance cost than a car not receiving such attention.

While on the subject of materials, it is important to note the growing interest in the use of car lumber which has received preservative treatment. Lumber so treated has received considerable attention from car builders and car owners for several years, and much of it is now in service. Sufficient time has not elapsed to indicate what increased life can be obtained, but experience to date indicates treated lumber to be more durable, and one that will resist moisture and decay.

The Marsh Refrigerator Service Company has used creosote-treated lumber in certain parts of its refrigerator cars, such as sills, sub-floors and roof boards, and appears to be the pioneer in the use of treated lumber in refrigerator cars. The writer has been advised that this lumber is giving excellent service, and that no objection can be made to it on account of any odor caused by treatment. The treated lumber in these cars is submerged for a number of hours in hot creosote oil, after which it is placed in a drip rack and permitted to drain. It is estimated that this treatment will result in large saving, doubling the life of the roofing boards and sills, and effecting considerable saving in labor that would otherwise be necessary to properly maintain these parts in the course of time.

An interesting report in connection with the use of treated lumber for use in the construction of cars was presented recently before the American Wood Preservers' Association. This report calls attention to the fact that decay is the principal cause of failures in lumber, and that great economy is possible by the use of a preservative.

It is evident that if some of the wooden parts of a refrigerator car can be made moisture proof or highly resistant to moisture, the efficiency of the car can be maintained at a much higher average.

The writer has been advised that some refrigerator cars are in service in which Balsa wood is the principal insulating material. This wood is very light in weight, having in its natural state a density of 7.1 lb. per cu. ft. It is a South American wood that grows very rapidly, and is of cellular structure. Table 2 shows it to have a thermal conductivity of 7.5 in its natural state and 8.3 when treated with waterproofing compounds.

It would be of great interest to know if treated or untreated Balsa wood is used between the ordinary walls of a car as insulation, or if the material figures largely in the construction of the superstructure of the car, such as lining and sheathing. Its strength is insufficient for its use in framing. It would also be of interest to know if the material is durable and efficient in this class of service, if any modification of car structure is necessary for its use, and if any reduction of car weight can be accomplished by its employment.

### Some Other Systems of Refrigeration

A previous statement indicated that some reference would be made to other systems of refrigeration. In the cars de-

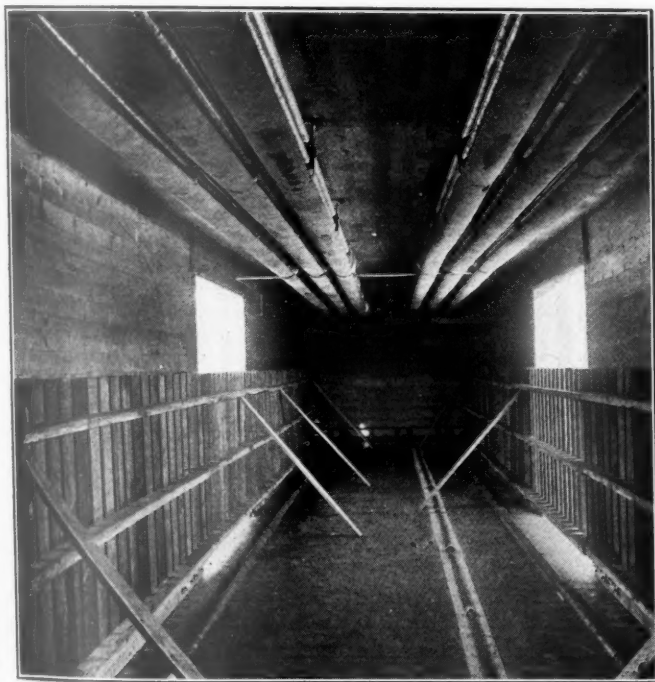


Fig. 17—Car with Overhead Brine Tanks, Showing Also Heater Pipes on Floor

scribed in the cross sections and tabulation, refrigeration is accomplished by means of air circulation, the air being cooled by contact with ice or ice containers placed at the ends of the car.

One modification of this system is a car in which ice containers are placed just below the roof and in the center of the car. In this system it is claimed that maximum refrigeration can be applied where the air within the car is at its highest temperature.

There do not appear to be a great number of cars of this type in modern service. The principal objections to such a system are decreased head room in the center of the car, weight of ice near the roof of the car, and difficulty of adopting this system for use with meat racks placed below the ceiling of the car.

Another system consists of a brine tank built into the roof at each end of the car. These tanks extend about 9 in. below the ceiling and are heavily insulated on top, sides and bottom. The tanks at each end of the car are connected to each other by pipes hung about 2 or 3 in. below the ceiling. The pipes are not insulated. In each tank is a partition running lengthwise of the car. In one partition are some check valves opening to the right; in the other partition some check valves open to the left. The theory is that when ice and salt are placed in the two tanks the swaying of the car in motion automatically circulates the brine through the pipes, refrigeration being accomplished by contact of the air within the car against the surface of the pipes connecting the two tanks. Comparatively speaking, this system has not been in service a very great length of time. The advantages claimed for it are increased loading space, decreased consumption of ice, uniform temperatures, and a car that can easily be changed from a refrigerator to a heater car. The writer understands that these cars are being tested in various fields of service. It would be interesting to have some information regarding the ability of this system to supply refrigeration when the car is not in motion, and what the system can accomplish in the way of quick pre-cooling when the car is placed at the loading shed or platform.

The interior of such a car is shown in Fig. 17. This illustration shows the floor racks propped up against the side walls so that the piping along the floor beneath the racks can be seen. This piping is used when the system is used to heat the contents of the car. Canvas troughs are placed beneath the piping located beneath the ceiling in order to catch any condensation or frost slush that may drop from these pipes.

### Pre-Cooling

The importance of pre-cooling the lading and the resulting economy in the use of ice and labor were mentioned in a preceding paragraph. There are two distinct methods of pre-cooling cars and lading. The first is known as shippers' pre-cooling; and the lading is placed in cold storage rooms in which the proper temperature is maintained, and where the lading is allowed to remain until it cools to the proper temperature, after which it is loaded quickly into cars that have been pre-iced. The second method is known as the carriers' pre-cooling, and generally consists of a system in which the car is loaded, after which the interior of the car and the lading are pre-cooled by mechanical means, usually by forced circulation of cold air.

Great economies are possible due to pre-cooling. Where small tonnage originates little pre-cooling has been done by mechanical methods on account of the high cost of the plant and equipment. Most mechanical pre-cooling is done where large tonnage originates. At such points the shippers frequently combine to build such a plant. Pre-cooling is receiving more and more attention in connection with various commodities and additional economy in the way of ice and labor may be expected.

### General Conclusion

The inquiries upon which these few notes on railway refrigerator cars are based, indicate that a very great improvement has been made in refrigerator-car construction and design, particularly within the last few years, but there is also evident indication that the field of investigation in connection with cars of this type is still a most fertile one. Some fairly recent cars indicate that subject of refrigeration in transit is not appreciated in some quarters as it should be. The subject of efficient refrigeration is a most important one, because cars that can be kept in continuous service with a minimum cost of maintenance and which are sufficiently efficient to protect the lading in transit, mean dollars and cents to the railways.



View of North Side of North Track Showing Elevated Runway Used by Rivet Burners and Backout Men

## Cutting Steel Car and Locomotive Boiler Rivets

Alleged Disadvantages of Electric Rivet Cutting  
Discounted by Installation on Chesapeake & Ohio

By E. A. Murray,

Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

FOR several years the practice of burning off rivet heads on steel cars with the electric arc has been in vogue at the Chesapeake & Ohio shops at this point. Recently this method was extended to locomotive boilers and we find that we can obtain equal success burning off rivet heads on boilers as well as steel cars. For cutting rivets we use a General Electric motor generator set, which consists of a 2,000-ampere, 80-volt, direct-current generator, direct connected to a 225-hp., 440-volt, induction motor. This set is operated by a manually operated starting compensator which is equipped with overload relay and no-voltage release.

The slate control panel, 5 ft. 4 in. by 3 ft. 4 in. in size, is equipped with an ammeter of 3,000 amperes rating, a 0 to 120 voltmeter, a polyphase watt-hour meter, circuit breakers and a rheostat for adjusting the voltage of the welding generator.

The rivet burning tracks are situated about 10 ft. from the generator room. They consist of two tracks about 5 ft. apart and are 450 ft. long. The rails are bonded at each joint with No. 0000 rail bonds. In addition to this the four rails are bonded together by  $\frac{1}{2}$  in. by 3 in. iron bonds every 40 ft. Running between the two tracks and on the outside of each track is a substantial wood scaffold 6 ft. high with a 3-ft. walkway which extends the entire length of tracks. These are used in cutting rivets which cannot be reached from the ground. On the middle scaffold directly beneath the walkway there is a  $1\frac{1}{2}$ -in. solid copper bar running the entire length of the platform. To this is connected at intervals of every 40 ft. a Cutler-Hammer, type T.C. grid resistance bar. These grids have a resistance of .04 ohms. and will allow each operator to use a maximum of 500 amperes. The feeders running direct from the control panel in the generator room consist of two 1,000,000 circular mil, slow-burning cables. These are run under ground in waterproof boxes. The positive line is connected direct to the bonded rails, while the negative side runs up to and is connected to the  $1\frac{1}{2}$ -in. solid copper bar. The resistance boxes are connected between

this bar and the leads of the special cutting electrodes.

The cutting tool, Fig. 2, is 35 in. long and is made of a piece of  $\frac{1}{2}$ -in. square copper rounded about  $1\frac{1}{2}$  in. on each end and threaded with  $\frac{1}{2}$ -in. standard threads. The square part is covered the entire length with a round wood handle *W*, Fig. 2, which is split in halves and grooved to fit the copper bar. The two halves of the handle are glued together and in addition to this a metal hose clamp is placed on each end. To one of the threaded ends is screwed a female brass connection. This connection is cast in the

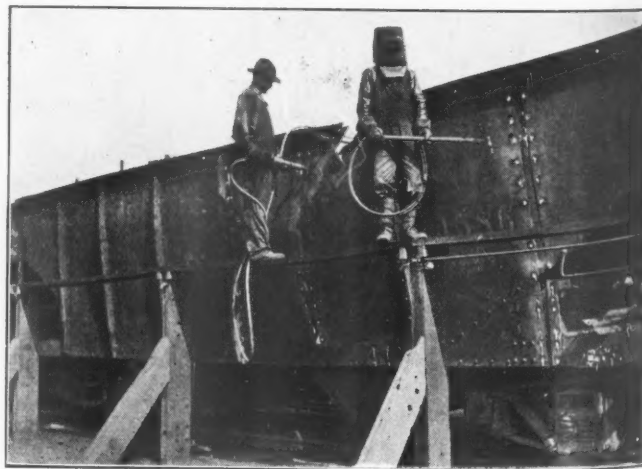


Fig. 1—After the Rivet Heads Are Burned Off the Rivets Are Backed Out With a Pneumatic Tool

shape of  $\frac{3}{4}$ -in. rod; it is 4 in. long, one end being tapped  $\frac{3}{4}$  in. deep with  $\frac{1}{2}$ -in. standard thread. The other end has a  $5/16$ -in. slot in it 3 in. long. Through this end are drilled two  $5/16$ -in. holes for bolting two  $\frac{1}{8}$  in. by 1 in. by 6 in. clamps, *C*, which have the ends forged to fit graphite sticks,

G, 1 in. in diameter. These clamps also have a 7/16-in. hole drilled about 2 in. from the end for a 3/8-in. bolt by which the carbon is tightened in the clamp. The clamps are forged on the end so that when the cutting tool is in a horizontal position, the carbon is at an angle of 45 deg. The total weight of this tool is 4 1/2 lb. Connected to each resistance box by means of copper terminals are two No. 2 General Electric flexible arc welding cables 50 ft. long. On the other end is soldered a female connector which screws into the cutting tool. When the operator finishes cutting on one car, he unscrews his tool and goes to the next car where he can attach the tool to the next lines. This does away with the work of carrying the heavy leads from place to place.

We get the best results with about 500 amperes and 55 volts at the arc. An operator easily cuts four 1-in. rivet heads in a minute and averages about 1,000 rivets in eight hours.

For cutting rivets on the bottom of cars or flat surfaces we use the same tool with the addition of a 3/8-in. air pipe, A, Fig. 2, attached and so bent that the end points directly at tip of the carbon. The flow of air is controlled by a small push

made in doing this work by this process. This work was formerly done by using rivet busters which were found to be unsatisfactory, especially is this true when the car sheets are thin and badly deteriorated. This method has proved so

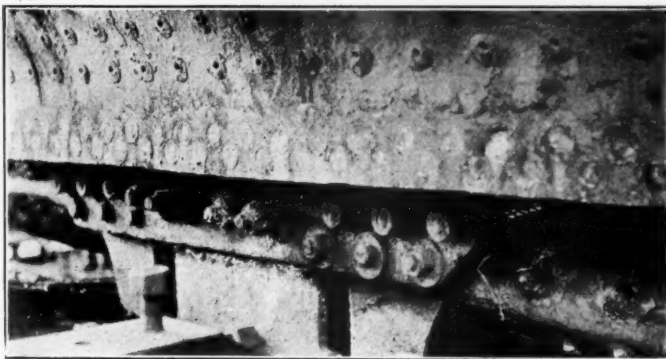


Fig. 3—Locomotive Fire Box. Rivet Heads on Mud Ring Have Been Burned Off

satisfactory that it has also been applied in the locomotive department. Fig. 3 shows an example of the work done.

## White Gasoline Rail Car

A NEW design of gasoline propelled motor passenger car, having a seating capacity for 41 persons and a baggage compartment, has been developed by the White Company, Cleveland, Ohio. The first car of this type, built for the Union Transportation Company, recently made a demonstration trip over the Pennsylvania Railroad from Philadelphia to Washington, where it was on exhibition during the annual meeting of the American Short Line Railroad Association. The car made daily runs during the



Fig. 2—Burning Tool in Use on a Flat Surface

valve, V, on the side of the tool handle. When the operator makes an arc on a rivet in the floor and the metal starts to run, he pushes the valve and the air jet blows the molten metal away making a clean cut.

At present we are using 10 operators in cutting steel car rivets. We formerly used carbon sticks in the rivet burners, but on account of the great durability of the graphite sticks, we discontinued the use of the carbon. We find that the graphite sticks burn off from five to six times as many rivets as the carbon and give considerably better service. The carbon electrode will heat over its full length and in some cases burn the holder, while the graphite heats only about 2 in. from the end on which the arc is produced and does not burn the holder.

Our records show that a saving of 50 per cent is being



Interior of the Passenger Compartment

convention over the tracks of the Washington & Old Dominion Railway, carrying as passengers representatives of the various short line roads.

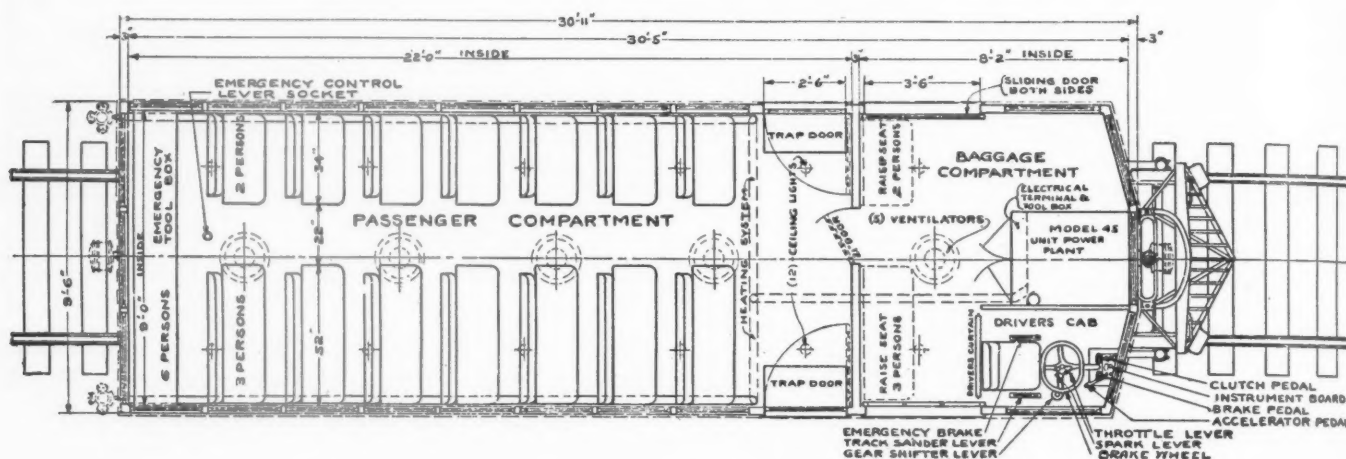
The trips over the Great Falls division of the Washington & Old Dominion were considered a severe test for the car as the road is a succession of grades and curves, the grades running as high as 3 1/2 to 4 per cent and the curves up to 10 deg. The car ascended the grades with ease and a fair speed was maintained even under the most severe conditions. To demonstrate its reserve power the car was brought to a stop on some of the heaviest grades and again started. Under these conditions it accelerated readily and continued to the top of the grades without difficulty.

The new White gasoline rail car has a seating capacity

of 41, with a baggage compartment directly in the rear of the driver who controls the car from the right hand side. The body is of semi-steel construction built by the J. G. Brill Company, Philadelphia. It is mounted on a specially designed White rail car chassis with an I-beam frame. The car has a four-wheel pivotal truck in front and two driving wheels in the rear. It is designed for a speed of 33 miles an hour. This speed was maintained with ease on the

After being exhibited at Washington, the rail car was placed in operation on the line of the Union Transportation Company on a 25-mile run between Pemberton, N. J., and Hightstown.

This same company placed a 29-passenger rail car in service several months ago and its successful operation led to the purchase of the second car of larger capacity. The experience of the Union Transportation Company shows that



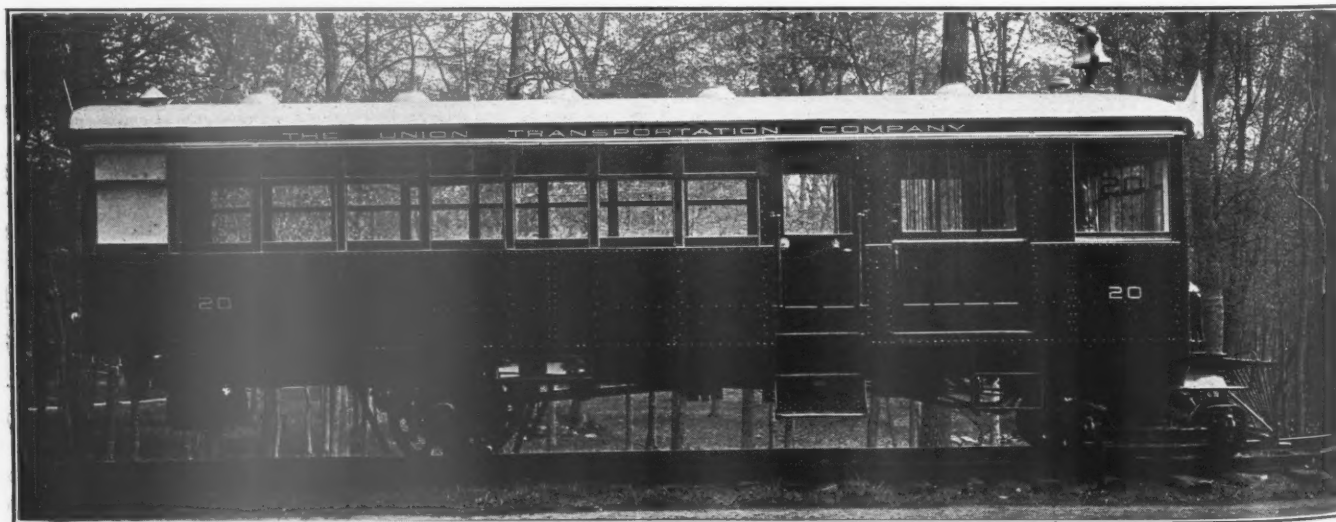
Floor Plan of the Car, Showing Arrangement of Compartments and Controls

demonstration run. The speed in reverse is 9 miles an hour.

The motor and transmission are identical with those used in the White motor truck, the engine, clutch and transmission being embodied in a unit power plant. The engine has four cylinders, cast "en bloc," with a  $4\frac{1}{4}$ -in. bore and a  $5\frac{3}{4}$ -in. stroke. The transmission is of the selective type with three speeds forward and one in reverse. The operating controls are located on the extreme forward right hand side of the coach. The foot throttle, clutch and drive shaft brakes are operated by pedals. The rear wheel brake and sander mechanism are controlled by levers and the brakes

passengers prefer to ride in gasoline rail cars rather than in steam trains. For this reason the gasoline rail car has been adopted because it offers an opportunity of giving more frequent service at a cost far below that resulting from the operation of short steam trains.

**VERY VARIED VALUES.**—Interesting examples of unusual sources from which scrap can be reclaimed are furnished by the practice of the Southern Pacific at its central reclamation plant. Sealing wax is obtained from worn-out dry cells; tin drinking cups



Exterior View of the White Rail Coach

on the pivotal truck by a hand wheel. Means are provided in the rear of the coach to disengage the clutch and apply the brakes in emergency. The rear axle has double reduction gear drive. The gears are entirely enclosed and run in oil. The rear wheels are of cast steel with locomotive type steel flanges and annular ball bearings. The seating arrangement and general dimensions of the body are shown in the drawing.

and grease cans are made from coffee cans; scrap boiler tubes are threaded or welded and used for water drain lines, air lines and conduits; old shovel blades are made into washers; parlene, a by-product of Pintsch gas plants, is used for painting the underframes of cars; scrap rope is unwound and used for binding company shipments instead of twine; sediment from acetylene generators is used in place of lime for whitewashing and in the company's steel foundry.

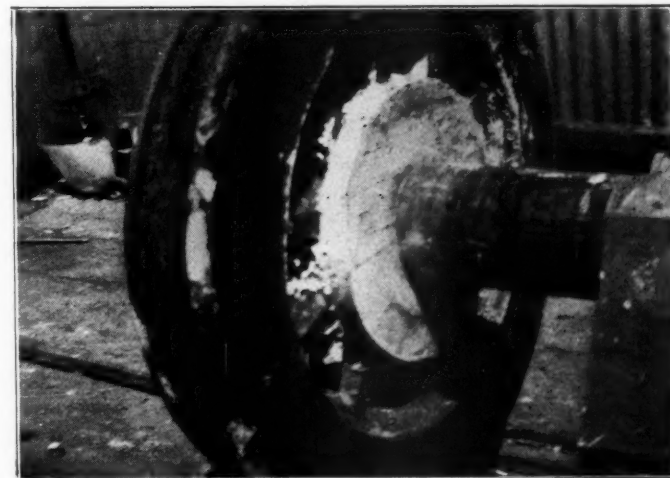
## Pouring Bronze Hub Liners on Engine Truck Wheels

By J. H. HAHN

Assistant Machine Shop Foreman, Norfolk & Western,  
Portsmouth, Ohio

A JIG has been developed at the Norfolk & Western shops, Portsmouth, Ohio, for pouring hub liners on engine truck wheels without the necessity and consequent delay of facing off these hub liners after they are poured. Details and an assembled view of this jig are shown in Fig. 1. Both the cost of applying the hub liners and the number of liners which must be applied are reduced about 50 per cent and due to the large number of engine truck wheels involved, the aggregate saving possible by the use of the jig is large.

The jig, as shown in Fig. 1, consists of a circular plate in two sections bored large enough to go over the journal. The sections are held together by two  $\frac{3}{4}$ -in. clamping bolts with special nuts, arrangement being made to hold the plate at the proper position on the journal by means of two brass tipped,  $\frac{7}{8}$ -in. set screws. The clivices and clamps are all attached to the circular plate in their proper relative positions

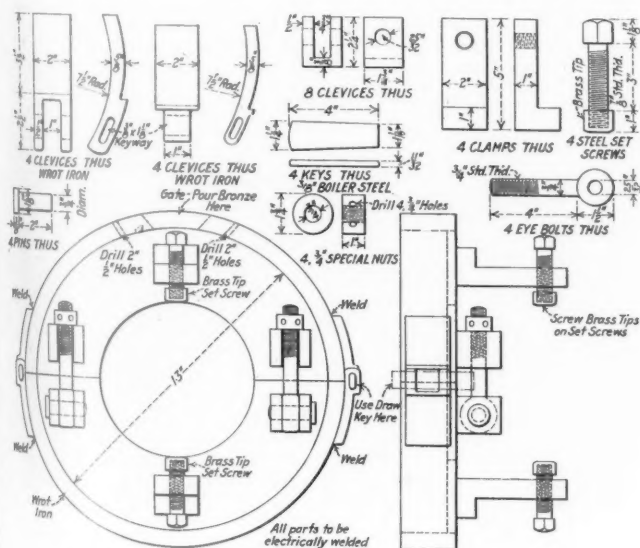


**Fig. 2—View Showing Bronze Liner after Being Poured**

asbestos is applied behind the jig to prevent bronze from running out over the spokes of the wheels; also between the circular plate and the journal when pouring liners on wheels with journals below the standard dimensions. The wheels do not have to be heated nor do they have to be up-ended. Both liners are poured at one time. The bronze is poured in the gate shown at the top of the jig and as soon as the metal has cooled sufficiently, the jig is removed. The box may then be applied, as liners poured by this method require no subsequent machining. Experience has shown that these liners give better service and wear longer than liners that are riveted on and the cost of application is reduced about 50 per cent. The hub liner just after being poured, cooled and the jig removed is shown in Fig. 2. Less than two per cent of the liners applied by this method crack after cooling in spite of the fact that the wheels are not preheated.

## Driving Boxes Machined in Record Time at Atlantic City

**A** PRODUCTION record of one driving box machined every hour and 15 minutes was made on a Morton heavy duty draw-cut railroad shaper, exhibited at the Atlantic City American Railway Association Convention in June. The Morton Manufacturing Company, Muskegon Heights, Mich., manufacturers of the machine, obtained from a prominent eastern railroad 24 heavy cast-steel driving boxes for the purposes of the test. The crown diameter of

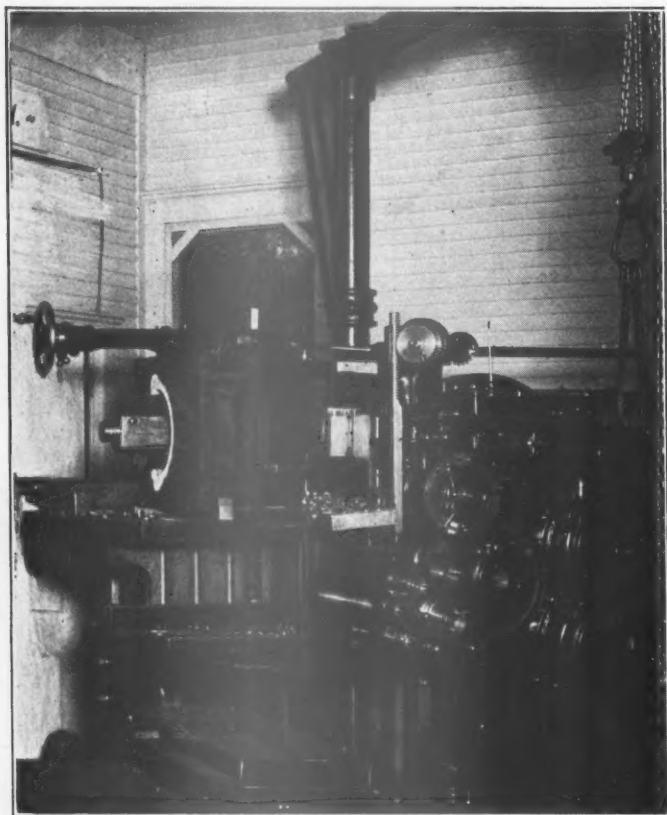


**Fig. 1—Details and Assembled View of Pouring Jig**

by electric welding. A circular band wide enough to accommodate the widest hub liner and provided with a pouring gate at the top is also arranged in two sections drawn tightly around the circular plate by draw keys as illustrated.

In applying hub liners by this method the first operation is to remove the old liners and machine the hub faces, cutting a recess about  $\frac{5}{8}$  in. deep by  $1\frac{1}{4}$  in. wide, dovetailed on

these driving boxes was  $12\frac{1}{4}$  in., the axle and cellar clearances being  $10\frac{5}{8}$  in. and  $12\frac{1}{8}$  in. respectively. The boxes measured about 13 in. parallel with the axis. The average stock removed from around the crown fit required a depth of cut of  $\frac{1}{2}$  to  $\frac{3}{4}$  in. In other words, the finished diameter of the crown was increased from 1 to  $1\frac{1}{2}$  in. over the rough diameter. The average material removed from the axle clearance was from 1 in. to  $1\frac{3}{8}$  in. on each side. The exceptional amount of stock on the axle clearance was explained as being an allowance to serve as a riser in the casting in order to insure a better grade of material.



Morton Draw Cut Shaper Used in Driving Box Machining Test

The order of operations was as follows: A driving box was first placed in the special holding chuck, as illustrated, being lined and clamped firmly in position for machining. The box was laid out in position in the chuck. Material was first removed from the axle clearance. In the early part of the test the entire amount of stock was removed at one cut from 1 in. to  $1\frac{3}{8}$  in. deep, using a  $1/16$  to  $3/32$  in. feed. This practice had to be discontinued, however, due to lack of a suitable rigid foundation on which to bolt the machine and driving motor. The stock was then removed in two cuts using a greater feed. The machine was set with the ram centered for machining the crown, a tool being placed in the tool holder and the material notched out to the depth of cut for the crown. The same tool roughed out a large share of the stock for the under-cut lug fit. The tool was then changed and the entire stock removed from the crown fit. The feed during this cut varied from  $3/32$  to  $1/8$  in. for the different boxes and the operation required about 20 or 25 min.

In ordinary practice the smoothness of the roughing cut would be sufficient for the finished box but in this case an allowance of .005 in. was made for a finishing cut. Before taking the finishing cut, the undercut lug fit was finished, this being a short operation because of the special forming tool used and a special relieving attachment, giving the tool proper clearance, eliminating back drag on the work and making a straight lug fit. The 24 driving boxes were machined in the axle clearances, the crown fits (roughing and finishing

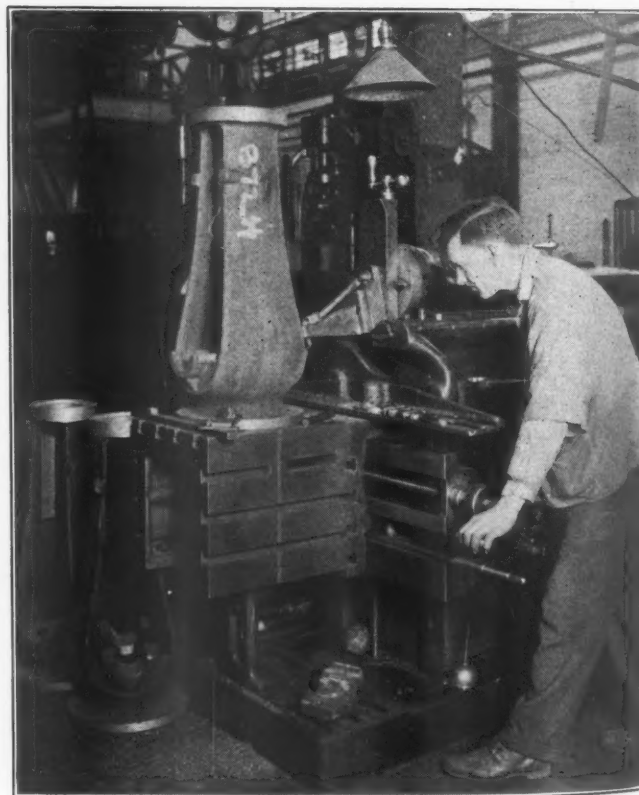
cut) and the under-cut lug fits, the average time being one hour and 15 minutes (floor to floor) per driving box. The chuck used for holding the driving box is so designed that a second driving box can be placed on the machine and laid out while the first is being cut. This method was not used at the convention, however, on account of the limited space occupied by the machine. As shown in the illustration the crane could not swing far enough to handle the second box.

The machine exhibited at the convention was electrically driven and provided with attachments for chucking driving boxes and machining crown brasses, the faces of shoes and wedges after being laid out, and rod brasses. The heavy cuts taken in this test and the accuracy of the finished boxes were made possible by the well-balanced, rigid construction of the draw-cut shaper and especially the stiffness inherent in the Morton ram design.

### An Unusual Shaper Job

The illustration shows an out-of-the-ordinary job performed on a 24-in. Gould & Eberhardt shaper with economy from the viewpoint of handling the work, ease of setting up the job and actual cutting time. The operation consists of planing the bearing seats for the caps on compressor frames. A special extension tool holder with an over reach of 6 in. beyond the regular tool position is used. It enables the tool to plane the entire length of the bearing ( $4\frac{5}{8}$  in.) without having the shaper head interfere with the compressor frame.

The two sides of one bearing are planed; then the casting is turned through 180 deg., bringing the opposite bearing in



Short Planing Job Done on Gould & Eberhardt Shaper

place to be planed. With a strongly supported table a shaper is well adapted to holding heavy castings and on account of the convenient size table, permitting the operator to work on three sides, the work of setting up is facilitated. The rigid construction of the ram permits taking heavy cuts in roughing operations and accurate finishing cuts.

Actual time studies proved that a saving of 30 per cent in time for handling and setting up and machining the casting is being effected by using the shaper instead of a planer.

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Packing Ring Tested for Accuracy

performance of locomotives at a lower cost than when purchased from the manufacturers. The greater portion of these rings are machined in the manufacturing department of the main repair shop where suitable machines are equipped and assigned to this work. An increased production of high quality and accurately made rings is thus obtained at a minimum cost.

### Piston Packing Rings

Two grades of piston packing rings are machined. One is made from ordinary grey iron for use exclusively in the cylinders of saturated steam locomotives and in the low pressure cylinders of Mallet type locomotives. The other

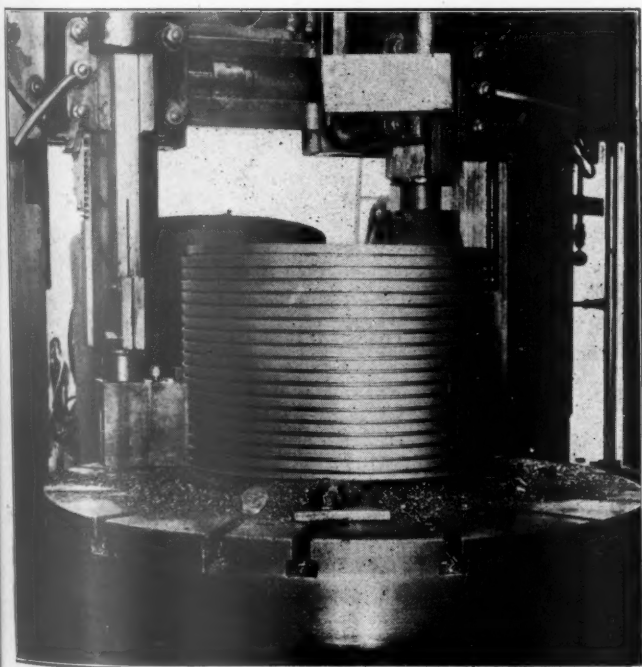


Fig. 1—Boring Inside Surface of Packing Tub Automatically Severs the Finished Packing Rings

grade of rings is made from high grade cast iron for use in the cylinders of superheated steam locomotives.

Piston packing rings are machined from castings commonly called packing tubs, from which an average of 18 finished rings are turned. These tubs are cast with four lugs on the bottom for the purpose of bolting the casting to the table of the machine. Piston packing rings are machined on vertical boring mills, one of which is shown in Fig. 1, five operations being necessary to finish 18 rings from one casting.

## Manufacturing Piston and Valve Rings

Details of a Method of Manufacturing Durable Packing Rings at Low Cost; Production Results Obtained

By A. G. W.

**A** PROMINENT railroad in eastern territory manufactures all piston and valve packing rings in its own shops as it has been demonstrated that an adequate supply of finished rings can be made and kept in stock for the main-

tenance of locomotives at a lower cost than when purchased from the manufacturers.

Operation 1—Top of casting faced, using right head.

Operation 2—Outside diameter of the casting rough turned, using right head.

Operation 3—Grooves cut in casting with four-cutter gang tool, using left head.

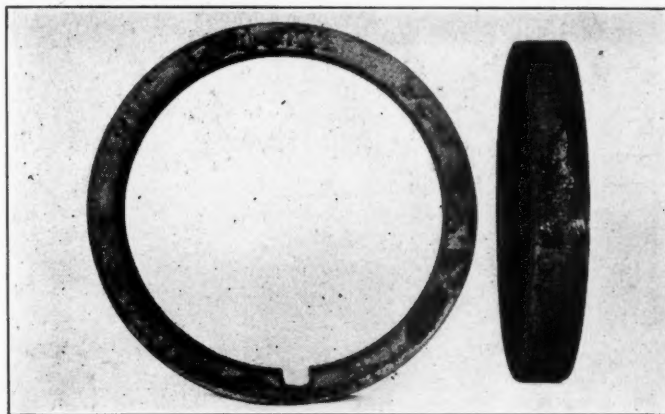


Fig. 2—Rough Packing Tub from which Two Valve Packing Rings Are Made

Operation 4—Outside diameter of casting finished, using right head.

Operation 5—Inside surface of casting rough bored to finish size which severs rings from the casting.

In the performance of the above operations, two heads of the machine are operated simultaneously whenever practical.

After Operation 1 has been performed with the right head, Operation 2 is started with the same head and proceeds until about 4 in. of the outside surface of the casting has been rough turned, when Operation 3 is started and both operations proceed simultaneously until Operation 2 is completed. By the time Operation 2 has been completed, 12 grooves have been cut by Operation 3 which is discontinued while the outside of the casting is finished by Operation 4. The grooving operation is again resumed with the left head and the right head is used to perform Operation 5 which consists of rough boring the inside surface of the casting to finished size. This operation automatically severs the rings from the casting, as shown in Fig. 1.

An average of 45 piston packing rings (30 in. or less in diameter) are machined on one boring mill in the above mentioned shop by one machine operator during an eight-hour shift. One 52-in. vertical boring mill, continuously assigned to machining piston packing rings and operated eight hours each day, will produce an average output of approximately 13,770 high grade and accurately made rings annually.

### Valve Packing Rings

Valve packing rings are machined from packing tubs made of a high grade cast iron, two finished rings being turned from each packing tub. While it has been found practical to machine these rings from tubs cast with an opening across the casting to allow for tension, this style of tub is not used because it is covered by a patent, for the use of which a royalty must be paid. Therefore, the tubs now used are cast with a  $\frac{5}{8}$  in. by 1 in. groove across the inside surface

of the casting, making the casting about 7/16 in. thick at the groove, as shown in Fig. 2. This necessitates sawing out a section of the casting at the groove to allow for spring, a method which has proved entirely satisfactory.

Valve packing rings are sawed on power hack saws and machined on semi-automatic machines. One operation on the saw and nine operations on two semi-automatic machines finish two rings from one casting, one ring being completely machined on one automatic (Fig. 3) and the second ring of the same casting completely machined on another automatic

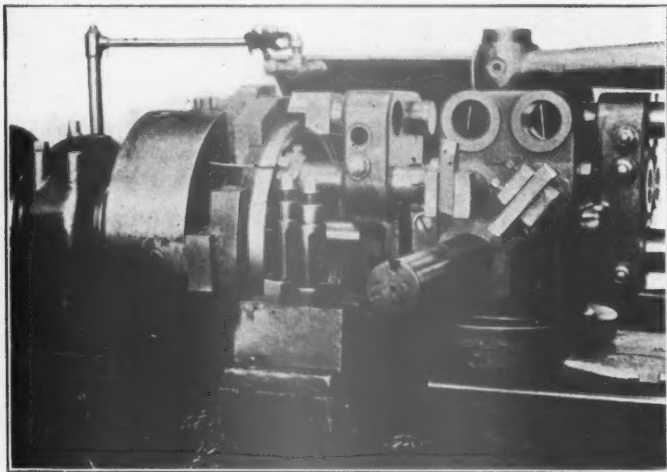


Fig. 3—Turning and Boring One Valve Packing Ring on First Semi-Automatic Machine

(Fig. 4). Both of the above machines are operated simultaneously and by one operator.

The operations necessary to machine valve packing rings are performed in the following order:

Operation 1—Piece sawed from ring at groove (1/2-in. piece sawed from 12-in. ring and 9/16-in. piece sawed from 14-in. ring).

Operation 2—Packing casting chucked in semi-automatic machine with a 3/32-in. metal liner applied in opening.

Operation 3—One side of casting (one ring) rough ma-

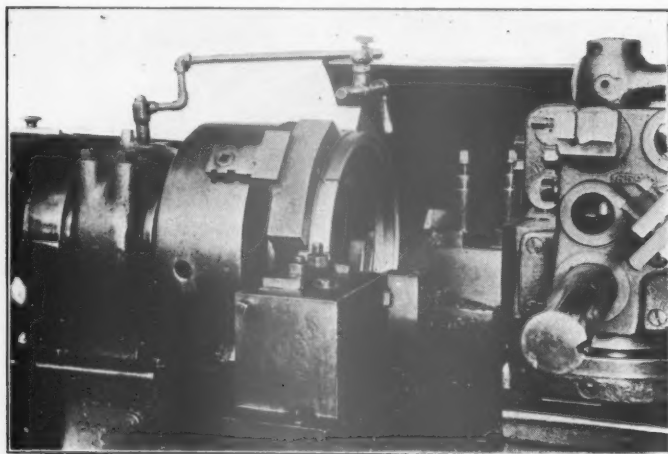


Fig. 4—Cutting First Ring from Tub and Facing Second Ring

chined (includes inside surface and counterbore rough bored, face and outside surface rough turned), all of Operation 3 being performed simultaneously, as shown in Fig. 3.

Operation 4—Same side as above, finishing cut (includes inside surface and counterbore bored to finished size, face and outside surface turned to finished size), all of Operation 4 being performed simultaneously.

Operation 5—Casting removed from machine ready for second machine.

Operation 6—Finished side of casting chucked in another semi-automatic machine, as shown in Fig. 4.

Operation 7—Other side of casting (one ring) roughed (includes inside surface and counterbore rough bored, face and outside surface rough turned, all of Operation 7 being performed simultaneously).

Operation 8—Same side as above, finishing cut (includes inside surface and counterbore bored to finished size, face and outside surface turned to finished size), all of Operation 8 being performed simultaneously.

Operation 9—First ring cut from casting and remaining ring faced to finished size, as shown in Fig. 4.

Operation 10—Second ring removed from machine.

Operation 11—Finished rings gaged in a ring gage by operator to insure against defective work.

Operation 12—Operator's initials and size of ring stencilled on ring with steel stencils and ring placed in cabinet ready for inspector.

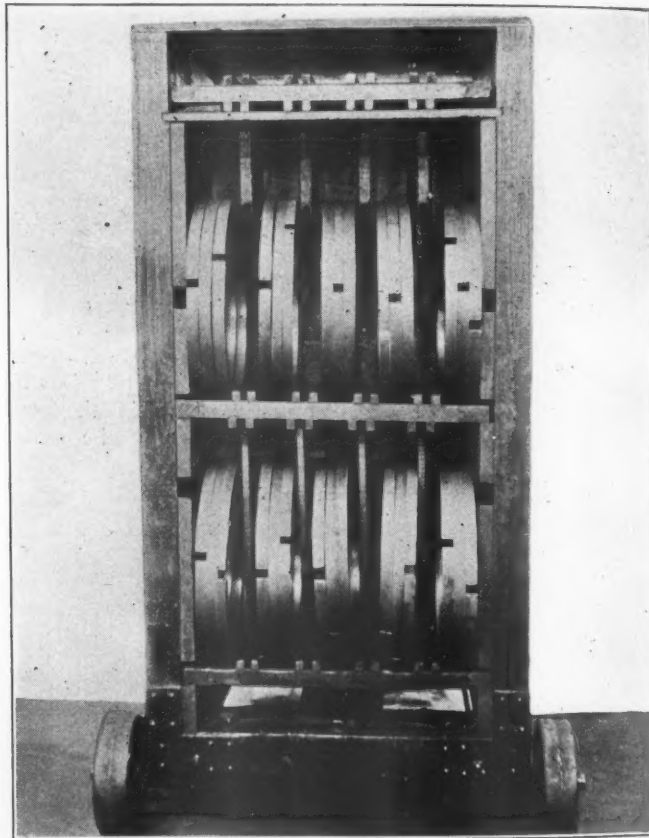


Fig. 5—Portable Cabinet in which Valve Packing Rings Are Placed as Completed

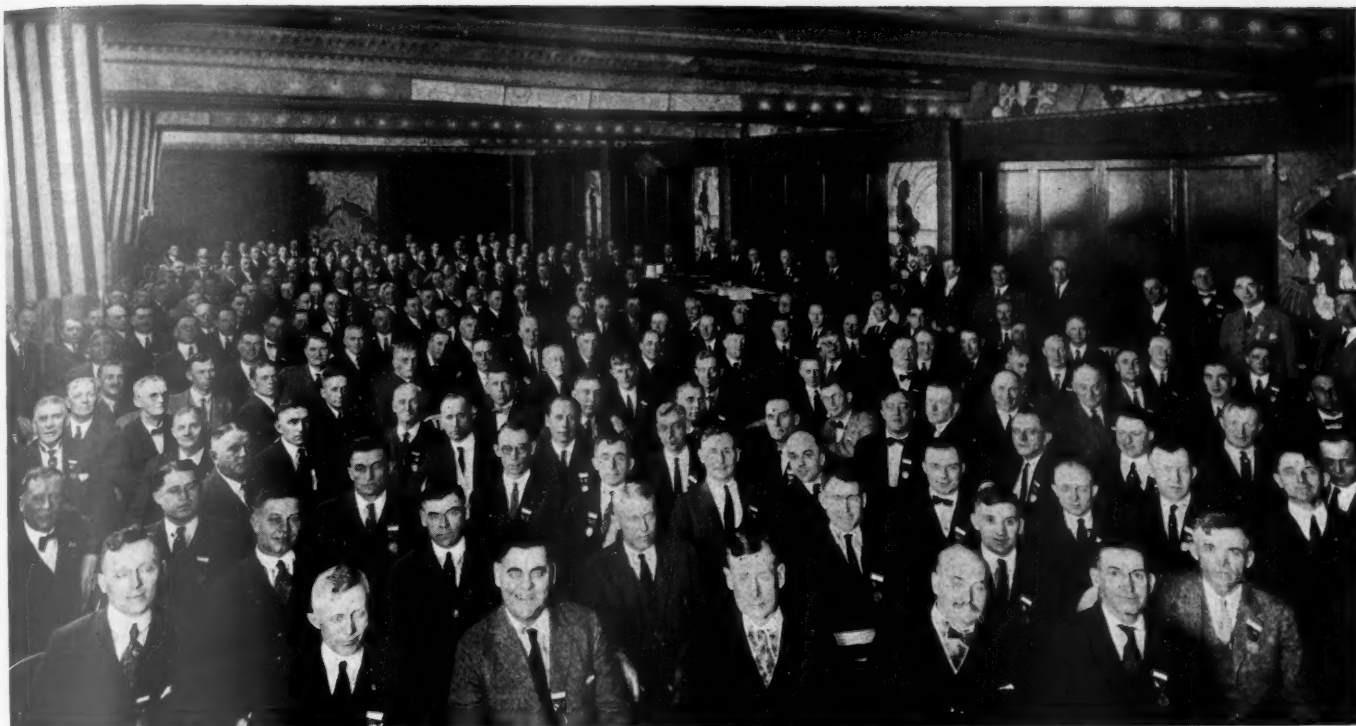
Fig. 5 shows a cabinet in which the operator places completed rings.

Two semi-automatic machines are operated by one man, performing Operations 2, 3, 4 and 5 on one machine and Operations 6, 7, 8, 9 and 10 on the other machine. Both machines are in operation continuously except when Operations 2, 5, 6 and 10 are being performed, at which time one machine is in operation.

An average of 40 castings, equivalent to 80 rings, can be sawed on one power hack saw during one eight-hour shift. An average of 22 rings are machined from 11, 12-in. castings on two semi-automatic machines operated by one man during one eight-hour shift. Twenty rings are machined from 10 14-in. castings on two semi-automatic machines operated by one machine operating during one eight-hour shift.

All packing rings are thoroughly inspected by competent inspectors before being delivered to the storehouse. The rings are inspected for workmanship and accuracy as well as being gaged and it is found that 95 per cent of the rings gage within .003 in. of being perfectly round.

The records indicate that the rings manufactured from this type of casting give exceptionally good service.



*Master Boiler Makers Assembled for the Opening of the Convention.*

## Master Boiler Makers Hold Annual Convention

### Survey Made of Autogenous Welding Practice on Principal Roads and Methods of Treating Hard Water

**T**HE thirteenth annual convention of the Master Boiler Makers' Association opened Tuesday, May 23, at the Hotel Sherman, Chicago, with Charles A. Patrick, president of the association, in the chair. During the course of the meetings about 275 members registered, which number included representatives of practically every road in the country. The opening invocation was given by past-president John H. Smythe, chaplain of the association.

In the absence of Mayor Thompson, who was to have addressed the association, his representative, W. D. Saltied, assistant corporation counsel of Chicago, extended official greetings to the association.

#### Mechanical Problems to Be Solved

H. T. Bentley, superintendent of motive power of the Chicago & North Western, then described the real work of the convention by outlining certain problems facing not only the boiler makers on the railroads today, but every man interested in the construction, maintenance and operation of locomotives. An abstract of his remarks follows:

Water treatment and purification have not received the attention necessary although a few roads which have pioneered in this work are now reaping real benefits from their investment. Formerly it was considered economy on most roads to use solid staybolts and drill tell-tale holes in place, but undoubtedly most of the roads now purchase hollow bolts, eliminating a great deal of work. The ordinary sheet steel ashpan is a constant bill of expense and it has taken us a long time to learn that the cast-steel pan can be installed and maintained at a much lower cost.

Now that flexible staybolts have gotten beyond the experimental stage there is an opportunity for the association to investigate the effect that these bolts have on the life of fire-

box sheets and whether they are more economical for complete equipment on an engine where it is necessary to remove the caps every two years or to put in hollow bolts and inspect them every 30 days.

The fuel saving problem can be materially improved by checking the flue cleaners and being sure that boilers are properly washed out and air leaks in the front ends and around the outside steam pipes eliminated.

All members of the association undoubtedly appreciate the good results obtained by using hot water to wash out and fill locomotives. This is especially important in connection with the efforts of the railroads to conserve fuel. Advantage should be taken of hot water for this work whenever practicable.

#### Association Business

President Patrick's address was followed by the report of the secretary, H. D. Vought, and the treasurer, W. H. Laughridge, who gave the financial statement of the association for the period ended March 31, 1922. F. W. Fritchie, master mechanic of the Baltimore & Ohio, and representing the Master Boiler Makers' Association on the Bolt, Nut and Rivet Proportions Committee of the American Society of Mechanical Engineers' Standards Committee, reported the progress made at the organization meeting held March 16. The work of the committee has been divided among seven special committees.

#### Promoting Locomotive Safety

At the opening of the Wednesday session, A. G. Pack, chief inspector, Bureau of Locomotive Inspection of the Interstate Commerce Commission, addressed the association on the duty which both the Bureau of Inspection and the mem-

bers of the Master Boiler Makers' Association must perform in constructing and repairing boilers in such a manner that they will render economic service without unnecessary peril to those who are called upon to operate them.

Approximately 70,000 locomotive boilers come under the jurisdiction of the chief inspector and an opportunity is afforded to the department to better observe the general conditions of motive power in the country than is given to any other group of individuals. Investigations of accidents due to the failure of boilers and their appurtenances indicate conditions which impress upon those responsible for the construction, inspection, repair and operation of such boilers, the necessity for great care and thoroughness in their work. Many of the most insignificant causes oftentimes lead to disastrous explosions. One instance of this recently coming to the attention of the department was the case of a washout plug bushing which blew out of a boiler carrying 200 lb. pressure. This accident resulted in the death of two men with the serious injury of three others. Upon investigation it was disclosed that the hole in the back head where the bushing had been inserted was practically void of threads, it having been only slightly scratched by the tap when the bushing was originally applied.

A number of accidents reported to the bureau have been caused by ends of broken staybolts blowing out of firebox sheets while being calked. It was found that the tell-tale hole in each case was either riveted over or plugged. Leaky staybolts, crown stays and firebox sheets do not contribute to the efficient operation of locomotives nor do the defective,

means of construction and repair could be more profitably as well as more safely used. This statement does not imply opposition to autogenous welding where it can be safely, properly and economically employed, but only where, through failure, increased loss of life and property result.

Autogenous welding is one of the great modern inventions. Its judicious use can be made to accomplish great savings in time and money, but it has not yet reached the state of perfection where it can be safely used on any part of a high pressure boiler wholly in tension while under working conditions or where the strain to which the structure is subjected is not carried by other construction which meets the requirements of the law. These conclusions are based upon conditions brought out in reports covering accident investigations in which autogenously welded seams were involved. During the fiscal years 1916 to 1921, inclusive, the records show that there were 81 crown sheet failures in which autogenous welded seams were involved, in 63 of which the welding failed. From July 1, 1916, to May 1, 1922, these seams have been involved in 22.1 per cent of the crown sheet failures, causing 44.1 per cent of the total number of fatal accidents. It has been said that these accidents were primarily caused by low water permitting the crown sheet to become overheated but the violence of the explosion and the consequent results were greatly increased by the failure of the seams.

Another condition, which has on many occasions been stressed by the bureau, is the application of arch tubes. There have been many cases where the tubes did not extend



C. P. Patrick, Retiring President      Thomas Lewis, President

H. D. Vought, Secretary

W. H. Laughridge, Treasurer

unsafe and inefficient operation of locomotives contribute to the efficient operation of the railroads.

#### Number of Boiler Accidents Decreasing

Since the establishment of the locomotive boiler inspection law the number of accidents and casualties has been greatly decreased. The comparison of the first nine months of the current fiscal year with the same period of 1912 shows a decrease of 67 per cent in the number of accidents, 74 per cent decrease in the number of persons killed and a 67 per cent decrease in the number of persons injured due to the failure of some part of the locomotive boiler only. This result has been brought about by the requirements of systematic inspection and repairs, not before consistently carried out.

It is a comparatively easy job to wash a boiler thoroughly and properly and clean an arch tube, yet neglect of such work will necessitate repairs costing far more than the saving accomplished. Water registering appliances can be easily cleaned and maintained in a safe and proper condition yet some of the most disastrous explosions are caused by failure to keep these devices functioning.

Autogenous welding is frequently employed where other

through the sheet as well as where they did not extend far enough to be either belled or beaded over to secure them in place. Many such conditions have been found by the bureau inspectors in the course of their regular work and proper repairs required before accidents occurred. Other arch tubes have pulled out of the sheets resulting in serious injury and death.

Where arch tubes are used, they should be thoroughly washed each time the boiler is washed and scaled with an automatic cleaner at each monthly inspection. The great majority of the accidents which occur could be prevented by means which are known to every well-qualified mechanic, official and employee in charge of the inspection, repair and operation of locomotives and tenders. Every means should be practiced by members of the Master Boiler Makers' Association to safeguard the lives of the traveling public and those who operate the locomotives.

#### Report on Autogenous Welding

The purpose of this special committee was to investigate autogenous welding by personal observation owing to conflicting reports by different members on the floor of our

convention. Your committee has visited at least one shop on each of 25 railroads and as many as eight shops and roundhouses were visited on some of the railroads.

We found that autogenous welding for firebox repairs is used by every railroad visited and in most cases successfully. We do not believe that it is necessary to go into detail as to what is being done on the various roads by autogenous welding, other than to say that we found complete fireboxes with no rivets above the mud ring. Patches, collar patches around fire holes, corner patches, one-half and full side sheets, one-half flue sheets and one-half door sheets, cracks, checks out of staybolt holes and crown sheets and combustion chamber sheets are welded in. Your committee is satisfied from their investigation that, as a general proposition, autogenous welding of fireboxes is successful.

It is our opinion that inexperienced operators, poor welding material and improperly prepared work have been the principal causes of failures in autogenous welding.

#### Proper Materials Essential to Good Welding

From our observations and discussions with various boiler foremen, we have agreed that it is necessary that work be properly prepared; that openings be neither too large nor too small, and above all that they be kept free from dirt. To secure good welding, firebox sheets must be clean. It is necessary that any of the material used in the repairs going into the firebox should be just as good as the original firebox material, and it is our opinion that all welding wire should be made to specifications.

#### Welding Flues to Back Flue Sheet

The success of welding flues, whether done at the time of application or after the locomotive has been in service for some time, in our opinion, depends on several conditions which must be taken into account. Some of these are: feed water conditions, the kind of coal used, use of injectors, whether the firebox is with or without a combustion chamber, and whether or not the water is treated. This report was prepared by Thomas F. Powers (chairman), John Harthill, John F. Raps, H. J. Wandberg, C. E. Elkins and W. J. Murphy.

#### Discussion

An extended discussion took place following the reading of this paper, more or less limited to the method of applying flues and the use of the electric arc process in this work. A great many roads throughout the country operating in both good and bad water districts electric weld the flues in their boilers. Members of the association generally favor the method, but vary slightly in the procedure employed. In good water districts flues installed in the usual way by expanding in most cases give excellent service, many running for the entire four years allowed by the Interstate Commerce Commission.

In bad water districts the welding of superheater flues increases their life but most members did not believe that this held true for small tubes. Whether the tubes are welded or not, it is necessary to keep the scale removed from around them if they are to be maintained tight. Most railroads are successfully welding fireboxes, side sheets, half side sheets, door sheets and general firebox repairs. Care must be exercised in this work, however, that strains are carried by other construction than the welded parts.

#### Buttonhead or Taper Crown Stays

This report was prepared by Lewis Nicholas, Jr. (chairman), Thomas F. Powers and J. J. Mansfield, who recommended the general adoption of the crown stay with a large taper riveted over, for the following reasons:

1. That it is of ample strength.
2. Easier to apply than the buttonhead on account of being tapered.

3. Less work needed to replace it on account of the taper in the firebox; can be cut free in the roof sheet and firebox and driven clear of crown sheet, thereby avoiding a lot of extra work cleaning broken ends off the crown sheet where, as often happens, the bodies of bolts become fast between the braces and cannot be removed.

4. Easier to tighten and does not strip; can be pulled up tight regardless of the angle of the sheet.

5. Gives little or no trouble in service, while the buttonhead type of bolt leaks very easily and when it does leak it is hard to calk; if not calked properly it is wedged away from the sheet, making it necessary to renew the bolt.

6. Gives a cleaner crown sheet both on the water and fire sides of the sheet, and does not collect dirt and cinders as does the buttonhead; gives a more even head surface.

7. Can be made at less cost than the buttonhead stay.

8. Gives a saving in tool bills, both in making bolts and in reaming and tapping, as the one tap and reamer can be made to do for three or four diameters.

9. Can be carried in stock threaded at both ends ready for use.

#### Discussion

With coal-fired engines the buttonhead crown stay has given satisfactory service generally but where roads have converted their power to oil burners the taper radial has been found almost a necessity. The taper in such cases varies from 1½ in. to 2 in. in 12 in., many of the members favoring one or the other for reasons of added strength, ease of fitting to the sheets, etc.

On the Chicago & North Western when engines were first converted from coal to oil burners, a great many of the buttonheads were cut off and hammered over but they were found difficult to maintain. Taper bolts at first also gave considerable trouble. For 10 years, however, these bolts have been used satisfactorily having a 1½-in. taper.

In hard water districts the question of scale enters the problem and it seems reasonable that the additional heat conducting surface of the buttonhead bolt causes greater precipitation of scale adjacent to it with the result that a heavy coating of scale forms around the bolt. Any advantage of strength with this type bolt is more than counterbalanced by the greater tendency to scale formation.

The results of low water investigations where boilers are fitted in some cases with buttonhead bolts and in others with taper head bolts indicate that the former do not hold up any better than the latter. The experience of the Bureau of Locomotive Inspection has been that the hammered head radial bolt is one of the best bolts used in a locomotive boiler. They hold up under all ordinary conditions and leaks do not occur to a fraction of the extent that they do with buttonhead bolts.

The final conclusion of the majority of members was that the taper stay with the 1½-in. taper in 12 in. is the most satisfactory crown stay to use.

Abstracts of additional reports and discussions will appear in a subsequent issue of the *Railway Mechanical Engineer*.

The officers of the Master Boiler Makers' Association elected for 1922-1923 are: President, Thomas Lewis (L.V.); first vice-president, E. W. Young (C. M. & St. P.); second vice-president, Frank Gray (C. & A.); third vice-president, Thomas F. Powers (C. & N. W.); fourth vice-president, John F. Raps (I. C.); fifth vice-president, W. J. Murphy (P. R. R.); secretary, Harry D. Vought; treasurer, W. H. Laughridge (H. V.).

Executive Board for one year: Harry F. Weldin (P. R. R.); E. J. Reardon (I. C. C.); Capt. J. M. Guiry (G. N.). For two years: Henry J. Wandberg (C. M. & St. P.); George Austin (A. T. & S. F.); C. E. Elkins (M. P.). For three years: L. M. Stewart (A. C. L.); John Harthill (N. Y. C.); C. H. Browning (G. T.). L. M. Stewart was elected chairman of the executive board and E. J. Reardon, secretary.

# Principles of Oxyacetylene Fusion Welding

## Part Three—Welding Cast Iron

By Alfred S. Kinsey\*

THE oxyacetylene flame can weld any of the metals to be found in shop practice. Each metal, however, has its own peculiarities which must be respected by the welder if a good weld is to be obtained. One reason why some oxyacetylene welds fail is because the welder does not know enough about the physical and chemical properties of the metal with which he is working. It might not be amiss, therefore, to point out some of the principal characteristics of the metals being welded in railroad shops, and also explain the real reasons for certain practices during the making of the welds.

One of the most interesting and complex of such metals is cast iron, and no less interesting and involved are the problems to be met as, for example, in the oxyacetylene welding of a cast iron locomotive cylinder.

### Reasons for Ordinary Welding Practices

In order to make welds in cast iron of full tensile strength, non-porous and soft enough to be machined the following directions are offered:

1.—*Cast Iron Should Be Beveled for Welding.* In preparation for an oxyacetylene weld the two edges to be fused should be beveled at an angle of 45 deg. each, or a total angle of 90 deg. from one beveled surface to the other. If this vee is made less than 90 deg. the torch flame and the filling metal cannot be properly applied. If it is made wider there will be a waste of time, gases and filling metal. Single beveling will do for thicknesses of  $\frac{1}{4}$  to 1 in. Beyond that double beveling should be used, that is, each piece of metal should be beveled on one side from the top surface down to half of its thickness and then beveled the same way on the other side. When the two ends to be welded are joined they will form a double vee, first one being filled with welding rod and then the other by turning the job over.

The beveling of a weld is necessary in order that the flame of the torch may be able to apply the heat directly to the middle of the cast iron and melt it and so weld the bottom of the vee first.

The oxyacetylene cutting torch may be used to cut the bevel on a cast iron weld, or the beveling may be chipped or ground. The latest method is by the cutting torch.

2.—*Cast Iron Bevels Should Be Blunt at the Bottom.* The bottom of the bevel of a cast iron weld should be left about  $\frac{1}{8}$  in. thick for ordinary thicknesses of metal and for very thick iron the bluntness should be increased in proportion. The value of this lies in the fact that the flame will not melt the blunt edge too easily and burn the metal at that point before the adjacent surface is melted, as would probably be the case if the bottom of the bevel were left thin and sharp.

3.—*Separate Slightly the Two Edges of a Cast Iron Weld.* If the two ends of a cast iron weld are placed closely together there is the possibility of oxides being deposited at the bottom of the vee thereby weakening the weld. This may be avoided by leaving the edges about  $\frac{1}{8}$  in. apart for the small welds and farther apart for big castings.

4.—*Cast Iron Should Be Heated Slowly to a Dark Red.* It is possible to heat a piece of cast iron so quickly that the grain structure will be weakened. It also is possible to raise the temperature of an iron casting so fast that its chemical composition will be affected enough to change the nature of the metal. An oxyacetylene weld is obtained by fusion, that

is the metal is melted so that the two parts of the job may flow together and thus welded by allowing the mass to cool and become solid. Much of the success of this work depends on the proper heating and cooling of the metal, which is not difficult to accomplish and a welder will be well repaid for his efforts in this direction.

A piece of cast iron is composed of flat-sided grains each of which is formed of crystals of intricate and wonderful design. When the metal is heated from the cold to the red hot condition the grains expand due to the separation and



Fig. 1—Broken Locomotive Cylinder

unlocking of the crystals which form the grains. If the first heating is done slowly the crystals will disengage without injury to the grain structure and the expansion from the heat will take place without unequal strains being set up in the iron. And when the metal cools after the weld is finished the crystals will go back nearly to their former position without interference so that the original strength of the metal will be retained. But if the cast iron is heated too quickly the

\*Professor of Shop Practice, Stevens Institute of Technology, Advisory Service Engineer Air Reduction Company.

crystals will be torn apart in such a way as to prevent their proper reassembling, and shrinkage cracks will be likely to occur.

The proper way to heat a piece of cast iron is to whirl the flame by circling the torch and to see that the heat is not applied to any one spot long enough to make it red hot before the whole thickness of the metal at the weld feels the expanding effects of the heat.

5.—*Cast Iron Should Be Heated Adjacent to the Weld.* Before applying the flame down in the vee it should be played over the metal on each side of the vee so as to warm it up thoroughly. This will produce a gradual increase of size of

metal. This of course is also assuming that the welding rod is of proper composition.

A common mistake made in welding cast iron is to fail to have the welding rod and the base metal of the same temperature when melting. To drop thoroughly molten cast iron rod on the hot but still solid surface of the base metal may mean a difference in temperature of the two masses of over 500 deg. F., and good fusion could not possibly result. The filling metal would merely stick to the surface of the base metal and a light hammer blow could break the joint. Precaution should be taken during the making of the entire weld to avoid this pasting of the two metals. A good flux will of course do much to prevent the lack of fusion, but oxyacetylene welders rarely have a good excuse for making a cast iron weld of less than 90 per cent tensile efficiency, and in most cases the strength should be practically 100 per cent.

7.—*Cast Iron Should Not Be Overheated.* If after cast iron is brought to the molten condition the flame of the torch is held too close to the metal for some time the metal might be overheated or burnt. There is no excuse for this. When a piece of cast iron is reduced from the solid to the molten condition the cohesion which holds the grains of the metal together will be reduced from its full amount in the cold

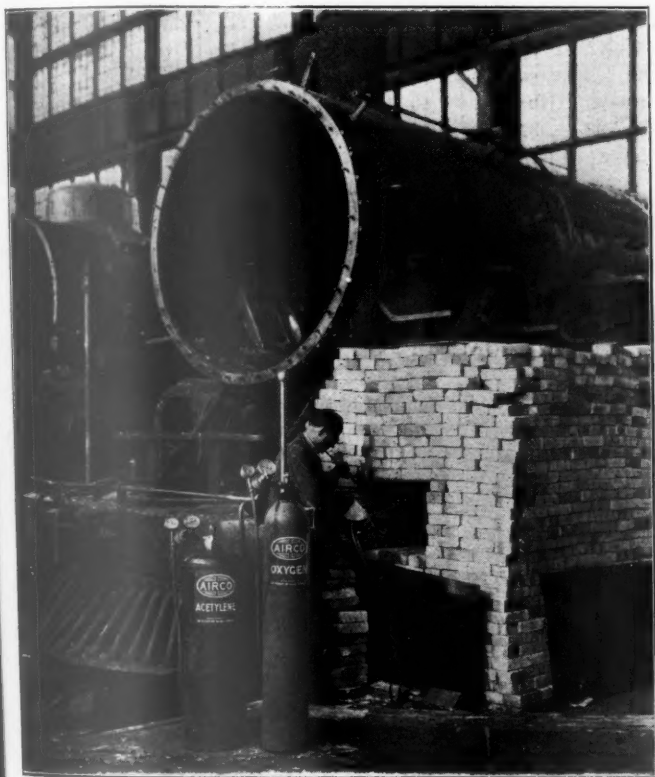


Fig. 2—Broken Locomotive Cylinder Bricked Up for Welding

grains from the smallest back of the weld in the cold metal up to the largest size grains in the molten metal at the weld. On the other hand if the edges to be welded are heated too quickly there will be a distinct line of weakness between the largest grains of the molten metal and the smallest ones of the cold metal which may develop to be a shrinkage crack or possibly a complete break in the metal. On small welds the oxyacetylene torch will prove to be the most economical means of adjacent heating. On big jobs the casting is likely to require complete preheating, for which other sources of heat would be applicable. The subject of preheating will be treated in a later chapter.

6.—*A Cast Iron Weld Should Be Thoroughly Fused.* Before the welding rod is melted down in the vee the surface upon which it is to fall should be thoroughly melted well into the metal. By holding the welding rod close to the flame it can be heated up slowly while the flame is bringing the base metal to the molten condition. Then by moving the rod into the flame it will be melted and fused with the molten base metal. The success of a good fusion weld depends mostly on the reuniting of the grains as the metal cools from the molten to the solid condition. If these grains could be brought together again at exactly equal temperature and without any oxides or slag between them, the original natural law of cohesion would be re-established and the metal of the weld would be as strong as the base

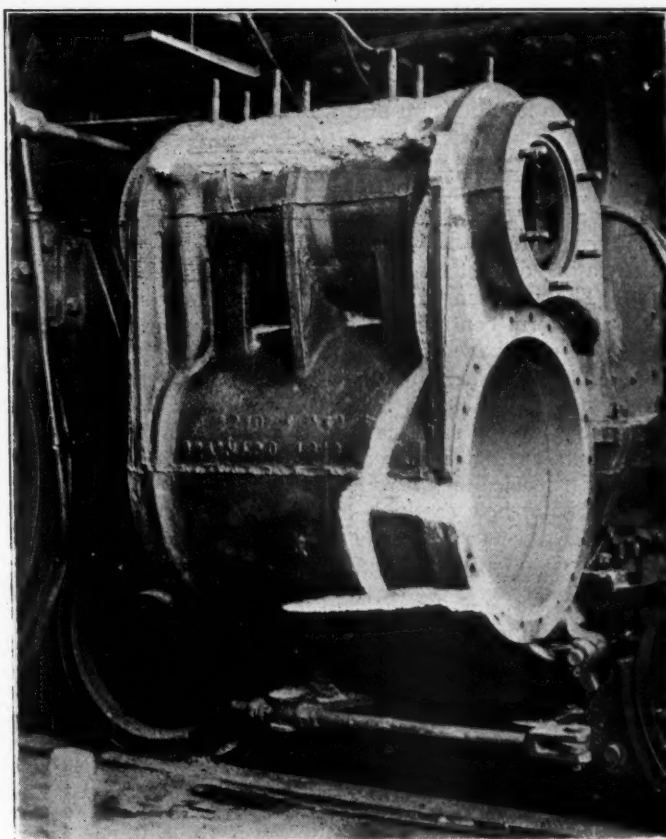


Fig. 3—Locomotive Cylinder Oxyacetylene Welded

metal to almost no cohesion when the metal is liquid. However, there is still sufficient cohesion between the grains to hold the mass together in the liquid state, and merely melting the iron has done it no harm. But if the heat is applied too closely and too long the cohesion will be entirely destroyed, the grains will separate and their surfaces will be coated with an iron oxide scale which will prevent them from reuniting and making a strong piece of metal again. This is burnt iron and is only fit for the scrap pile.

Another result of overheating a cast iron weld is that its chemical elements, carbon, silicon, manganese, phosphorus and sulphur, will be burnt out and thereby destroy the

natural characteristics of the metal. An oxyacetylene welder will have no difficulty in avoiding the overheating of a cast iron weld if he uses a good flux, keeps the torch flame properly adjusted and learns the appearance of clean molten cast iron as compared with superheated burnt metal.

8.—*Cast Iron Should Be Preheated.* By *preheating* is meant to heat the casting all over to a uniform temperature before starting to weld. This will be absolutely necessary in all castings so shaped that the welded section has not free play to expand and later to contract without setting up strains in adjacent parts of the casting or warping it. On the heaviest welds it is best to build fire bricks up around the job, leaving sufficient space to allow the preheating flames to circulate and heat the casting uniformly. No mortar is necessary. The bricks keep the heat over the casting and confine it there so that the casting will cool very slowly. If the job requires but a small amount of welding the bricks may be omitted and asbestos board used instead with satisfactory results.

The heat for preheating may be satisfactorily obtained from charcoal made of hard wood. Soft wood charcoal may throw off offensive gases. Hard wood charcoal will burn slowly and evenly without smoke or harmful gases, and usually does not require a blast to keep the fire going. It will hold a fire over 40 hours if necessary. Its chief advantage is that it does not burn with long flames to interfere with the welder. In the case of small jobs an oil burner or a gas jet or furnace may be used. A typical cast iron preheating job in railroad practice is a locomotive cylinder, Fig. 1. With its thick and thin walls, bridgings and passages, steam chest and fastenings, it would be impossible to weld the cylinder without preheating it. It should be bricked up carefully, Fig. 2, and iron rods laid inside and across the cylinder at the center of its diameter could form a grate for the charcoal fire.

Preheating of cast iron accomplishes three things:

(a) The uniform expansion of the metal so that there may be uniform contraction including the welded area, and thus avoid shrinkage cracks after the weld cools.

(b) The uniform relieving of all unequal strains which may have been set up in the casting when it was made in the foundry. Many castings contain these locked-up stresses which often are not discovered until long after the casting has been in service and it receives an unusual strain. Then it is surprising how easily it breaks.

(c) The uniform retention of the carbon contents of the iron. Cast iron contains carbon in two states, graphitic and combined. Graphitic carbon softens cast iron and makes it machinable, while combined carbon strengthens cast iron and makes it hard. The proper proportioning of these carbons determines the use of the casting in practice. It is quite possible to change the relative amounts of the carbons by the way it is allowed to cool from the liquid to the solid state.

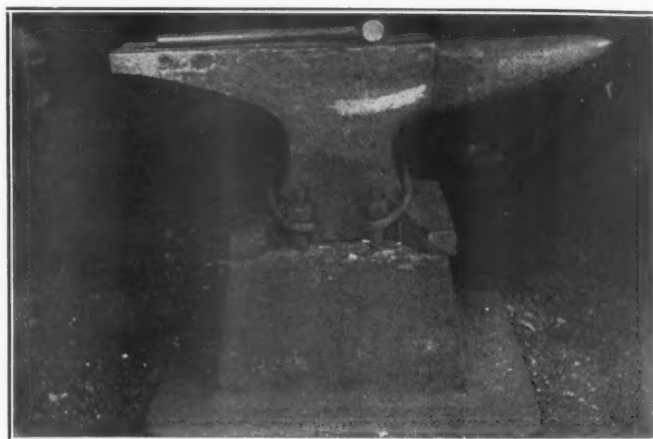
For example, the casting of a locomotive cylinder will contain say graphitic carbon about 2.75 per cent and combined carbon about .75 per cent. Now if the cylinder were to be welded with the oxyacetylene torch and it was not covered or preheated, when the red hot weld was completed it would cool very quickly in the air, which would cause the carbon to change so as to reverse the relation say to the extent of about .75 per cent graphitic carbon and 2.75 per cent combined carbon, thus leaving the casting so hard that it could not be tooled. The slow cooling after preheating prevents this transformation of the carbon. A good rule to follow is always to cool cast iron as slowly as possible after welding.

The temperature to which cast iron should be preheated varies somewhat with the shape of the casting. If the casting is of nearly uniform thickness throughout it should not be heated higher than about 600 deg. F., which is the point

where the surface of the casting still appears black and not at all red. If the casting has thick and thin parts it will be necessary to heat the whole casting to a dark red. Cast iron should never be preheated above a dark red. To go beyond that temperature, which is from 800 to 900 deg. F., would be liable to distort the casting by its own weight.

## Cast-Iron Anvil Block Demonstrates Value in Blacksmith Shop

There are few railroad men, particularly in the blacksmith shops, who have not at one time or another experienced difficulties with wooden anvil blocks. If a solid wood anvil block is properly set and the anvil securely fastened in place the block will doubtless have a relatively long life but it is not always easy to fasten the anvil rigidly and unless the block is set with unusual care it will not afford a solid foundation. These difficulties are entirely overcome by the



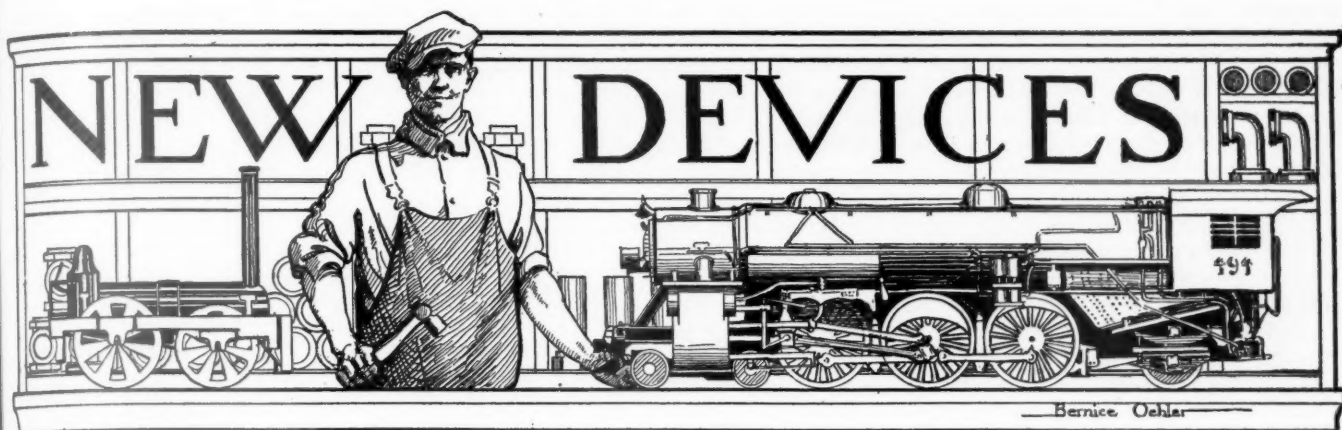
Durable Cast-Iron Anvil Block Used on the Chesapeake & Ohio

use of the cast-iron anvil block illustrated which is being used successfully in the Chesapeake & Ohio blacksmith shop at Huntington, W. Va. The block is provided with a substantial flanged base, having a wide bearing on the floor, and the effective method of fastening the anvil to the block is plainly shown in the illustration. Tightening the nuts on the studs will evidently draw the clamping irons and anvil firmly to the block.

## Thermit Weld Collar Inspection

One fact more responsible perhaps than any other for retarding the progress of welding is that when a weld is made it is impossible to determine without destroying it what strength is definitely assured and safe to allow. An examination of the surfaces of welds does not reveal this and certain well-known technical societies and associations interested in the possibilities of welding have greatly restricted the allowable application.

A thermit weld, however, by reason of its collar allows a careful inspection and drawing of accurate conclusions as to strength. An examination internally of the collar can be made without affecting the strength of the weld, the unsound welds being found and condemned. In practice this examination is made by gouging deep grooves in the thermit steel collars parallel with the axis of the piece, these grooves reaching almost to the original section itself. Two such grooves on the four sides of a thermit weld have been found to be sufficient. If these grooves are observed to be free and clean from blow hole defects, the inspector may be absolutely assured that the weld itself is sound.



## Hall Multiplate Friction Draft Gear

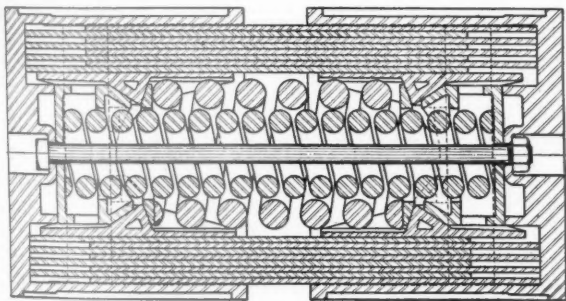
**A**FTER many experiments and tests to develop a draft gear with the maximum resistance to wear, high capacity, a moderate and positive release, sturdy in construction, simple to manufacture, and easily handled on application and repairs to rolling stock, the Hall Draft Gear Corporation, Watervliet, N. Y., has placed on the market the Hall multiplate friction draft gear.

A friction draft gear of proper design and manufacture should meet the following conditions: The resistance to wear should exceed the life of the equipment to which the draft gear is applied. The high resistance should build

abraded surfaces at approximately 800 lb. per sq. in. frictional pressure. This will be more or less depending on the hardness of the surfaces; therefore, in order to obtain a high capacity draft gear, using low friction pressure per square inch, it is necessary to have an extremely large friction area. This has been accomplished in the Hall multiplate gear by using soft spring steel plates in multiple.

The Class H draft gear, 9 in. by 12 $\frac{3}{4}$  in. by 24 $\frac{5}{8}$  in., illustrated, has 2,300 sq. in. of friction surface and a maximum pressure of 250 lb. per sq. in. setting up friction. This gives a mechanical combination which shows very little wear, high capacity and smooth action.

The cross-sectional drawing of the draft gear shows the arrangement of the wedges, wedge plates, springs, friction plates and housings. This draft gear is a self-contained unit without followers or loose pieces. It is symmetrical with respect to all axes and cannot be applied improperly. The standard draft gear is 9 in. by 12 $\frac{3}{4}$  in. by 24 $\frac{5}{8}$  in.; special draft gears 9 in. by 12 $\frac{3}{4}$  in. by 18 $\frac{1}{2}$  in., 8 $\frac{1}{2}$  in. by 12 $\frac{3}{4}$  in. by 15 $\frac{1}{2}$  in. and 12 $\frac{3}{4}$  in. by 15 in. by 24 $\frac{5}{8}$  in., are built to



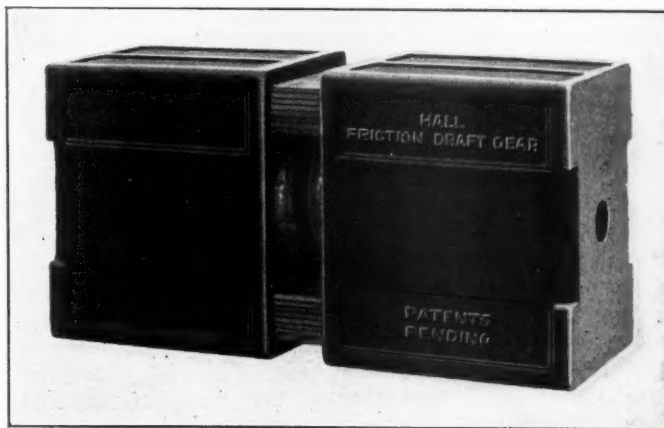
Cross Section Showing Working Parts of the Gear

up uniformly without sticking and jumping so as to keep the sill stresses at a minimum for the shocks absorbed. The release should be moderate and positive so as not to return more shock than necessary to the rolling stock, but at the same time insure a positive release in order that the draft gear will be ready for operation at any position of the coupler. Sturdy construction is necessary if the draft gear is to give continuous service without repairs, as there is always more or less liability of rough handling of rolling stock. The first cost should be kept down to the minimum; this likewise applies to application and repairs. The draft gear should be a self-contained unit, as application is much simplified if there are no bothersome loose pieces.

It is a well-established fact that friction tends to increase uniformly with the pressure up to the point at which the surfaces in contact begin to seize and abrasion starts. If the friction pressure is low enough there will be practically no wear and if any occurs, the surfaces will be smooth and uniform.

If the friction pressure is too high, scoring, irregular wearing and rapid breaking down of the friction surfaces takes place, which greatly reduces the capacity and life of the draft gear.

Steel in sliding contact without lubrication will show



The Hall Multiple Friction Draft Gear is a Self-Contained Unit

interchange with existing sill pockets. The latter size is for 100 ton and heavier equipment, the spring capacity having been doubled and the friction area greatly increased in order to give approximately double the capacity of the standard draft gear.

The draft gear casing may be described as two identical cast steel housings with open ends towards each other, separated 2 $\frac{3}{4}$  in., or whatever travel the draft gear is designed and set up for. The friction plates are rolled steel of 0.60 to 0.70 per cent carbon content, alternately arranged to move

in unison with the housings due to contact at one end of each plate. The weight of the standard gear is 470 lb.

Frictional resistance is created by pressure applied on these friction plates when the draft gear housings are forced towards each other. This pressure is applied by a wedge at each end of the draft gear which moves with the housing, forcing a pair of wedge plates against the friction plates, the amount of this pressure being determined by the pressure of the friction spring, which compresses as the draft gear is closed. The inner spring shown is the release spring, while the outer spring is the friction spring.

As soon as the buffing or pulling load on the housing terminates, the release spring forces the wedges out of contact with the wedge plates, thereby relieving the pressure on the friction plates. The friction spring then moves the housings, friction plates, draft gear attachments and coupler back to position. The release spring is also arranged to work in unison with the friction spring on release.

Due to both ends of the friction spring acting against a pair of wedge plates at each end of the draft gear, and both pairs of wedge plates being forced against the same friction plates, the arrangement allows a comparatively small capacity friction spring to be used in order to obtain a high friction resistance in this draft gear. The lateral pressure, tending to burst the housing, is comparatively small, due to the multiplicity of the friction plates and the small wedging pressures necessary for a high capacity.

In buffing or in pulling, the force is transmitted to the draft gear housings, tending to force one housing against the other. The resistance to this movement is offered by the internal or frictional parts of the draft gear up to the resistance capacity of the gear. With a force beyond this capacity the draft gear housings come in contact and resist further applied forces. The general design of these housings permits making the parts of sufficient strength to protect the frictional elements of the draft gear from damage, and at the same time to resist high buffing or pulling forces which may occur in the handling of rolling stock. The cross-sectional area of the casing is 23 sq. in. and the solid contact area 30 sq. in.

The draft gear is practically weather proof with all wedge arrangements well away from the central opening and can be applied to cars or locomotives with any design of draft yoke or draft attachments that provides a draft gear pocket of the standard dimensions or various existing draft gear pocket dimensions.

The results of tests of the H-2 gear under the A.R.A.

9,000 lb. drop test machine are shown in one of the drawings. A free fall of 30 in. or a total fall of  $32\frac{3}{4}$  in. was required to close the gear. The work done was 24,500 ft. lb. and the work absorbed 23,000 ft. lb.

Car impact tests of the H-2 gear were also made on the Symington tests plant at Rochester, N. Y., using the same 143,000 lb. cars and equipment used by the United States

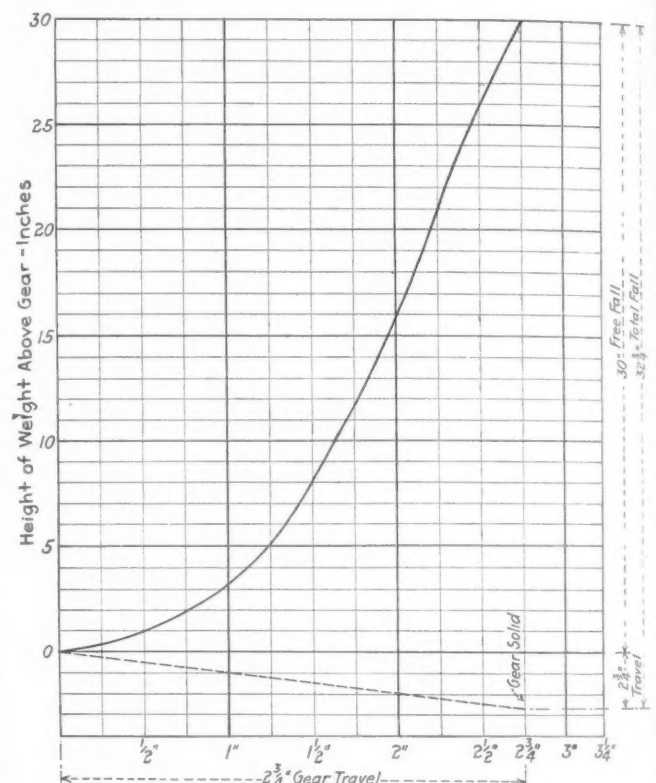


Diagram of Drop Tests of Hall H-2 Gear

Railroad Administration, so that comparison could be made with published data. The closing speed was found to be 5.23 m.p.h. Slow speed, solid speed and over-solid speed trials were made to study the draft gear action under various conditions. The gear showed favorable results as regards car movements, velocities, energy absorbed, smoothness of action and sill stresses set up.

## A New Type of Anti-Burglar Car Door Fastener

**I**MMENSE quantities of valuable freight are being shipped on the railroads with no other protection from theft than a flimsy car seal. Occasionally padlocks are used to secure the doors, but these can usually be pried off with a small bar and offer little additional protection. Considerable losses are sustained from theft of valuable freight. Recently a freight train on an important main line was stopped by bandits who broke into every car and searched it for valuable shipments. It happened that the bandits stopped the wrong train and the loss was small but the incident emphasizes the fact that ordinary methods of securing car doors offer no obstacles to theft. Because of the frequent loss of valuable shipments, some railroads have placed armed guards on trains. Other roads have spiked with heavy nails the doors of cars containing valuable merchandise. If the nails are driven in to the head, they cause delay in opening the cars and injury to the door. If allowed to protrude, they are easily removed and offer little resistance to thieves.

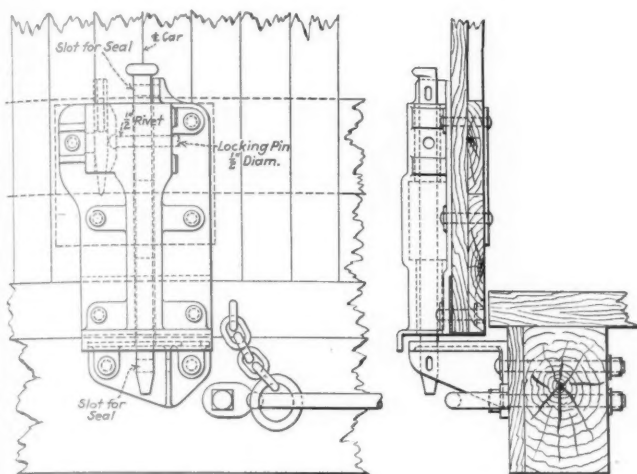
The Delaware, Lackawanna and Western for some time

followed the practice of nailing doors on merchandise cars but on account of the inconvenience and expense for repairs, J. C. Fritts, master car builder, designed a type of door lock which provides such effective protection that the railroad now dispenses with the service of train riders.

This fixture which is both simple and effective is illustrated in the drawing. It takes the place of locks and handles and does away with the necessity for special opening and closing devices. The usual locking fixtures at the side of the doors are replaced by a special fixture placed at the center of the bottom edge of the door. The door guides and stops at the bottom of the door are eliminated and a short chain attached to a horizontal rod keeps the door from swinging out more than a limited distance.

The principal feature of the door is the bottom door fastening which is shown in detail in the drawing. The lock consists of a heavy locking bolt about one inch square working in a housing attached to the car door. The lower end of the locking bolt engages a bracket attached to the side sill and the bolt can be sealed either through

the bracket or through a lug at the top of the housing. Near the top of the locking bolt is a  $9/16$  in. transverse hole which registers the corresponding holes in the housing. When it is desired to lock the door securely a  $1/2$  in. cold rivet



A Simple Door Fixture Which is Effective in Preventing Theft

is inserted through the housing and locking bolt. The head may be held in place by inserting a cold chisel, brake shoe key or any piece of iron of about the same size into the lugs

on the housing while the opposite end is upset with a hammer to prevent its removal. It is then necessary to cut the rivet with a chisel before the door can be opened.

Anyone attempting to remove the rivet would make so much disturbance as to attract attention and if an attempt was made to enter the car at night, it would be necessary to use a light which would probably betray the presence of the thief.

In addition to the anti-burglar feature, this fixture provides for locking the door in a slightly open position. This is useful for securing ventilation when handling certain commodities and is also a distinct advantage in facilitating checking empty cars in yards.

The chain door stop is advantageous in insuring that the door can be opened readily. In case the door posts are sprung or loads shifted against the door, it can be swung out to clear the obstruction, preventing damage which results from forcing doors open.

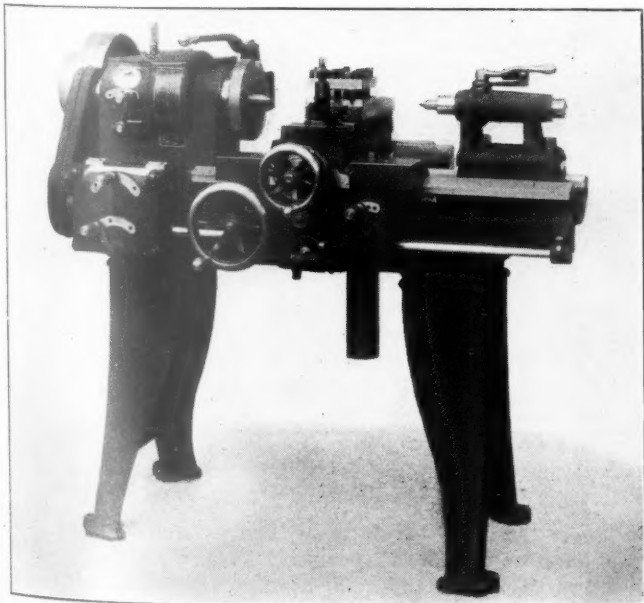
An important advantage of this fastening is its simplicity and cheapness. It requires but 22 bolts per car while the ordinary fixtures require from 48 to 60. The total cost is considerably less than one-half of the usual type of door fixtures which include guides and corner brackets. Moreover, the whole door mechanism and side of the car are much less expensive to maintain after its application because there is no damage to either door or sheathing in forcing the doors open and closed as is in many instances the case with the ordinary fixtures.

## High Duty Lathe for Small Diameter Turning

A NEW manufacturing lathe has been developed by the R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, designed for the small diameter turning and facing jobs encountered in manufacturing work. The essential features of the regular line of LeBlond heavy duty lathes are included in this machine such as selective speed, flooded lubrication, heavy duty bed, one-piece box section apron with

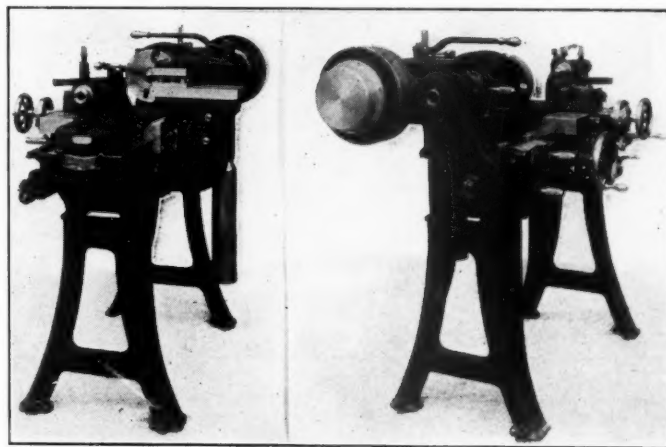
heavily ribbed oil tight casting. All gears and bearings are thus continuously flooded with oil. Two speed change levers control the six speeds and the starting lever applies a friction brake on the spindle as soon as the driving clutch is released. The spindle is provided with a large hole for passing work through it or mounting draw-in or expansion chucks, either hand or air-operated. This feature is valuable, permitting the manufacture of parts from bar stock.

The lathe is made with a plain block rest and No. 1 single screw tool post with collar and elevating wedge. On speci-



R. K. Le Blond 11-In. High Duty Lathe

positive feed clutch, heavy duty carriage and lever-operated quick-acting tail stock. Six speed changes are provided through sliding gears from a constant speed driving pulley. The spindle is of liberal proportions, running in taper bronze bearings adjustable for wear. Ball thrust bearings are provided, the entire mechanism being enclosed in a



End Views Showing Facing Attachment and Pulley Drive

fication a turret tool post can be provided. Nine changes of feed may be obtained by the simple manipulation of two change levers. The bottom lever compounds the range obtainable with the top lever, giving a quick change of feed for roughing and finishing cuts without the necessity of gradually stepping the feed up through gear combinations. The box is driven direct from the spindle by means of a roller sprocket chain adjustable for tension. The lever-operated, quick-acting tail stock is a recent improvement

arranged to permit the quick removal and replacing of work with a single movement of the operating handle.

For work requiring facing or grooving operations a facing attachment can be supplied, enabling these operations to be performed at the same time as turning. The application of the facing attachment converts the 11 in. rapid production lathe into a semi-automatic lathe performing turning and facing operations at the same time and covering a field of smaller and lighter work than can be handled on the LeBlond Multi Cut lathes. The facing attachment is mounted on a substantial bracket bolted to a planed pad on the rear of the bed and adjustable to any desired position along the

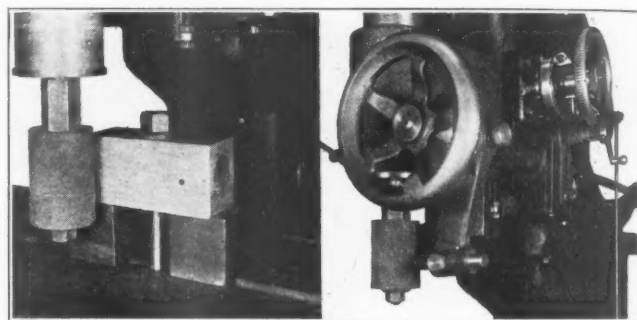
bed. A simple cast-iron form plate is bolted to and travels with the carriage. A roller on the facing attachment engages this form plate and transmits the motion through a rack and pinion to the facing slide which is set towards the center of the lathe on a broad, dovetailed slide. As the carriage is brought back along the bed to the starting position the facing attachment is also brought back automatically by the weight illustrated. This lathe has a capacity to turn work up to  $13\frac{3}{4}$  in. in diameter by  $18\frac{1}{2}$  in. long. The facing attachment will face  $2\frac{1}{2}$  in. on a side. Six spindle speeds are provided ranging from 50 to 250 r.p.m. Nine feeds can be obtained from .008 to .092 in. per revolution of the spindle.

## Radius Link and Link Block Grinder

**A** NEW radius-grinding machine, particularly adapted for grinding locomotive links and link blocks, has been developed by the Newton Machine Tool Works, Inc., Philadelphia, Pa., being shown in the illustrations.

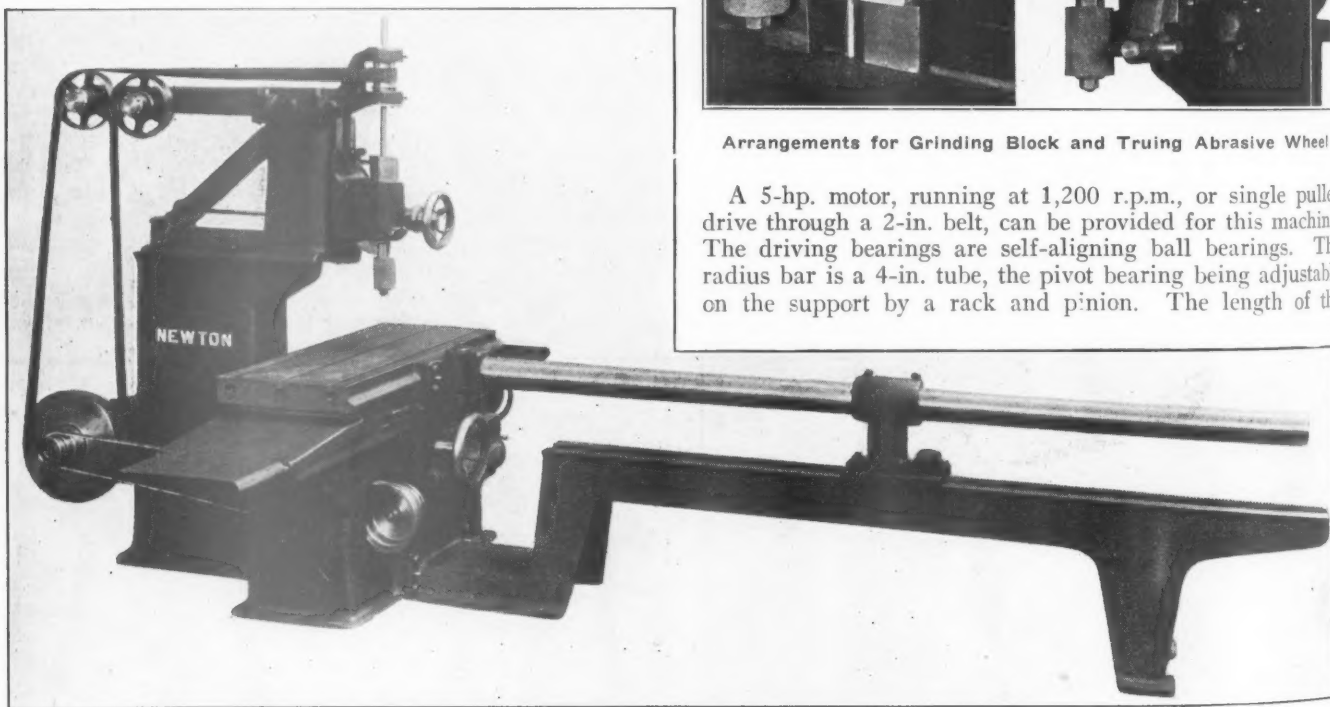
The table of this machine has hand adjustment and is reciprocated automatically by dogs. Three speeds of 5 ft. 3 in., 7 ft. 10 in. and 10 ft. 6 in. per min. are available. Arrangement is made to permit operation of the vertical feed to the wheel and remove pressure during reversal. The slide carrying the table is fitted at either end with cast-iron shields so that the bearing is never uncovered. The spindle of this machine has a taper end for the arbor fit, being provided with ball bearings. The driving pulley is carried on separate

ing blocks as well as links. This motion is brought to a convenient position for the operator. The wheel truing device is conveniently mounted so that the motion of the spindle slide is available for truing the wheel and the fixture can be readily swung out of position when not in use.



Arrangements for Grinding Block and Truing Abrasive Wheel

A 5-hp. motor, running at 1,200 r.p.m., or single pulley drive through a 2-in. belt, can be provided for this machine. The driving bearings are self-aligning ball bearings. The radius bar is a 4-in. tube, the pivot bearing being adjustable on the support by a rack and pinion. The length of the



General View of Newton Link Grinder Featured by Rigidity, Strength and Productive Capacity

ball bearings so there is no thrust on the spindle bearings other than that of rotation.

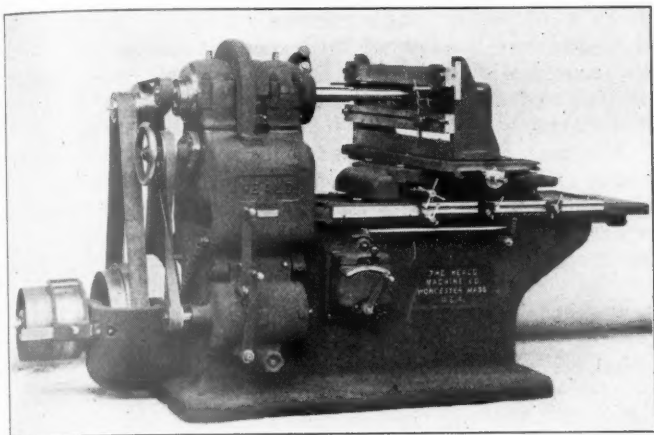
The spindle sleeve has a 3-in. adjustment in the slide. The spindle slide is counter-weighted and provided with hand adjustment, oscillating motion for using wide-face wheels and an intermittent feeding motion for narrow-face wheels, the latter motion being reversible by a ratchet box.

The spindle head is adjustable on the upright for setting the depth of cut and has sufficient movement to permit of grind-

radius is indicated by a scale. The minimum radius available is 18 in. and the maximum, 100 in. The recommended speed of the spindle is 6,000 r.p.m. The wheel spindle has horizontal adjustments of 6 in. for different widths of work. The table is 18 in. wide by 42 in. long, the maximum table stroke being 30 in. and the minimum, 2 in. It is said that when grinding a link 3 in. wide with .025 in. of metal removed from each side and 5 min. required to set up the job, the total time for grinding is 40 min. New and old links of this size require a total time of one hour.

## Wide Speed and Feed Range for Grinder Table

PERHAPS the most distinctive feature of the redesigned internal grinding machine, made by the Heald Machine Company, Worcester, Mass., is the hydraulic drive for the main table operated by oil. By the use of this drive any desired speed from nothing up to a maximum may



Heald No. 50 Internal Grinder with Hydraulic Table Drive

be instantly obtained. This feature of the machine is simple in design, silent in operation and has a minimum of parts to get out of order. The operator can reverse the table at any desired point without shock or noise. The main driving

shaft on the rear of this machine runs on ball bearings taking the power directly from the main line without a countershaft. The main table is heavy and wide, being provided with ample wearing surfaces. It is of sufficient length to fully protect the ways from grit and dirt.

The cross slide table gives crosswise adjustment of 28 in. to the work. The feed screw has a graduated dial reading in thousandths of an inch. Adjustable dogs are provided for indicating large dimensions, as when traveling from hole to hole. Vertical adjustment of the cross slide table is provided to the amount of 5/16 in., secured by means of two inclined slides located between the cross slide table and the main

The grinding head and feeding arrangement for the eccentric are similar in design to that used on previous Heald grinders except that they are heavier. The grinding spindle is driven from the main drive shaft through a flexible idler which maintains uniform belt tension at all times. The depth of cut is obtained by a feed mechanism on the right-hand end of the rotating head, operated either by a knob when small adjustment is required, or by a small crank when large adjustments are to be made. For varied work of large size a special spindle, either 15 in. or 18 in. in length handling large wheels and known as the Railroad Type 10 spindle is provided. The speeds of the standard grinding wheels are from 4,500 to 4,950 surface feet per min. The recommended speed of the tight and loose pulleys is 750 r.p.m. A 5-hp. motor, operating at 1,000 to 1,200 r.p.m. is recommended.

## Metallic Locomotive Feed Water Connections

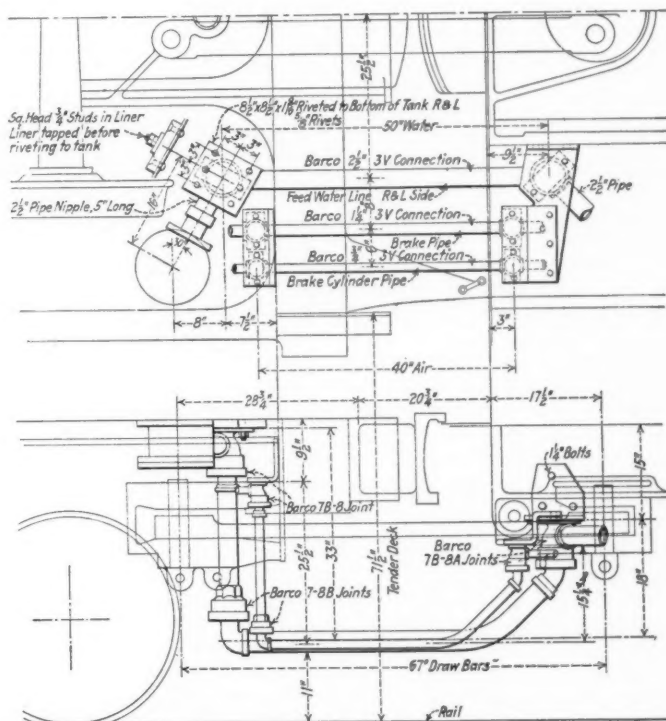
THE first application of flexible metallic connections to the feed water line between the engine and tender were applied in a single large pipe line on the center line of the locomotive, through which both injectors were fed. This type of connection met with some objection because of the possibility that a failure of this connection would completely cut off the feed water supply and cause an engine failure. The drawing shows an application of flexible Barco joints to the feed water line which provides a separate connection for each injector, this arrangement having been developed recently by the Barco Manufacturing Company, Chicago, Ill.

These connections are supported by a plate riveted to the bottom of the tank, to which the upper Barco joint is attached by means of two studs. A short nipple connects the joint with the tank well. By thus applying the connection directly to the tank instead of to the tender frame the possibility of leakage developing as the result of any slight shifting of the tank on the tender frame is eliminated, and the connection is raised well above the rail. The terminal joint on the locomotive end of the connection is secured to the deck in a similar manner, with a pipe connection leading from the joint to the strainer box at lower end of the injector feed pipe.

As is indicated on the drawing, the feed water connection is carried well into a line only about 25 in. from the center line of the locomotive.

Connections of this type have been in service on six Consolidation type locomotives on the Bangor and Aroostook for several months during the past winter, during which time the locomotives have averaged about 30,000 miles with no maintenance required to the feed water line. Under the severe climatic conditions prevailing during the winter months on this line, which require almost constant use of the heaters when the injectors are not working, it is estimated that the same service would have required at least

one and probably two renewals of the ordinary hose connections. In addition to the reduction in the cost of maintenance

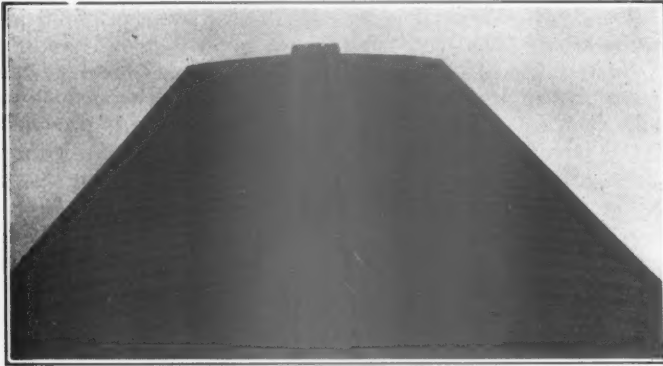


Application of Barco Flexible Metallic Connections to the Feed Water Line Between Engine and Tender

the pipe connections also insure against injector failures caused by the collapse of loose hose linings.

## Self-Supporting Corrugated Steel Freight Car Roof

**A** NEW design of freight car roof of the heavy gage, all-metal type, has been placed on the market by the Sharon Pressed Steel Company, Sharon, Pa. The roof is made of pressed sheets, continuous for the entire

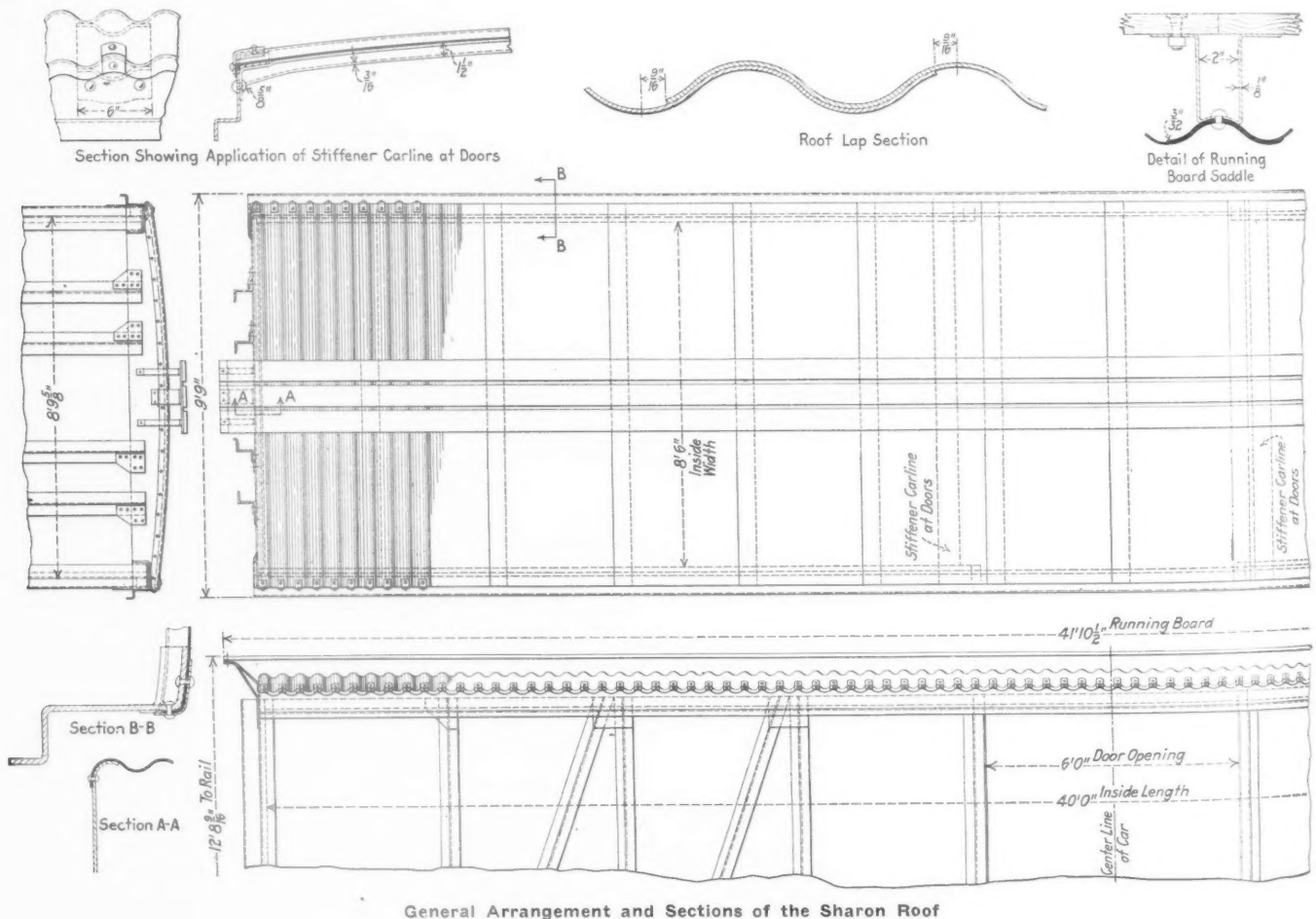


Sharon Pressed Steel Roof as Applied to the Car

width of the car. The sheets are of 14 gage steel, black or galvanized, and 20 to 40 in. wide, the length being made to suit the distance over the eaves. Each sheet has corrugations  $1\frac{1}{4}$  in. deep and 5 in. between centers, extending

the car to a pressed side plate, being riveted with short angle clips outside the sheet, as shown in the drawing. The side plate is of  $\frac{3}{16}$  in. or  $\frac{1}{4}$  in. material and is made continuous from end to end of the car. The design can be adapted to any type of car construction. A side plate of this type is approximately four times as strong as the  $\frac{5}{16}$  in. by 4 in. by 4 in. angle commonly used for this part, and is also lighter by about 120 lb. per car. The special end fascia used with the roof is of one piece, pressed to engage the end roof sheet, and riveted to the side plates. The running board is supported by light pressed steel saddles.

The roof complete weighs about 70 lb. per foot of car length. Each 40 in. sheet of 14 gage steel when securely fastened at the side plate will carry the following loads concentrated at the center or eaves: For cars 9 ft. wide, 940 lb.; for cars 9 ft. 6 in. wide, 890 lb., and for cars 10 ft. wide, 845 lb. The tensile strength to resist spreading at the sides is 40,000 lb. per sheet. The roof has sufficient play to take care of weaving of the car frame due to uneven track or unbalanced loading. The surface provides a firm foothold in case it is necessary for trainmen to walk at the side of the roof. The overlapping sheets make a watertight construction. No leakage was found even when the roof was tested with a heavy stream from a hose. In case a sheet needs to be replaced, it is only necessary to remove the rivets



General Arrangement and Sections of the Sharon Roof

transversely across the car. These corrugations act as stiffeners and give sufficient strength to support the roof without the use of ridge poles, carlines or purlines, so these parts are omitted except for one carline at each side of the door opening to stiffen the car frame.

The pressed steel sheets are laid with an overlap of one corrugation at each end. They are attached at the sides of

along each side, cut four rivets in the overlapping sheet and four in the clips.

For new cars this roof can be assembled at the manufacturer's plant and shipped as one piece ready for application to the car frame. When used for repairs the roof is applied in sections and, if desired, can be furnished with sheets of 22 gage steel put over the existing carlines and purlines.

# GENERAL NEWS

Samuel Gompers, president of the American Federation of Labor, was re-elected without opposition at the recent convention in Cincinnati, Ohio. It was his forty-first election to that office. Portland, Oregon, was chosen as the place for the next convention, which will be held in October, 1923.

Citizens of Palestine, Tex., are agitated over the expected removal of the International & Great Northern's shops from that city, and several heated conferences have been held between citizens and officers of the city, the citizens being determined to contest the contemplated removal. In behalf of bondholders a suit has been filed in the federal district court against the city of Palestine and the citizens, to enjoin them from interfering with the road's removal plans.

## Swiss Turbine Locomotive Tests

A few days ago the line from Zurich to Sargans was the scene of tests made by the Swiss Federal Railways of a turbine locomotive manufactured by the firm of Escher, Wyss & Co., Zurich. The results with regard to water and coal consumption are reported as being good.

## Tool Foremen's Convention

The convention of the American Railway Tool Foremen's Association will be held at the Hotel Sherman, Chicago, September 5-8, at the same time that the International Railway General Foremen's Association meets. The Supply Association of the American Railway Tool Foremen's Association is arranging to hold a convention and exhibit in connection with this joint meeting.

## Argentina Buys German Locomotives

The Argentine State Railways have ordered 50 locomotives from Germany, according to the Wall Street Journal. The Argentine Port Zones Authority has, according to the same publication, opened bids for 130 cars and 10 locomotives. Ninety concerns in the United States, England, Germany and Belgium bid on this business and, since the American bids were the lowest, it is thought that the contracts will come to this country.

## Railroad Not Liable as Garnishee for Wages Earned During Federal Control

A railroad company is not liable for wages earned by an employee, while he was employed by the Federal Railroad Administration in operating the company's properties, and such a railroad company cannot be required to respond as garnishee of funds from which such earnings are alleged to be due.—*Heuermann v. Huermann* (Missouri Pacific, Garnishee) (Mo. App.), 237 S. W. 893.

## Supplement No. 2 to the 1921 Rules of Interchange

A supplement to the 1921 Rules of Interchange has been prepared by the Arbitration Committee and the Committee on Prices for Labor and Materials. This supplement, in addition to interpretations of existing rules by the Arbitration Committee, announces the extensions of the effective dates of certain rules which are to become effective during the year 1922; also labor allowances for R. & R. or R. of Transom Draft Gear and Parts, recommended by the Committee on Principles for Labor and Materials.

## Minnesota Car Repair Shed Law Declared Invalid

A statute passed by the Minnesota legislature requiring railroads and other concerns who build or repair cars and car trucks to provide shelters for the protection of workmen from inclement

weather, was declared null and void in a decision rendered by Federal Judge W. F. Booth at Winona, Minn., on May 15. The decision grants the Chicago & North Western a permanent injunction restraining the Minnesota Railroad & Warehouse Commission and the attorney general of the state from enforcing the statute in question.

## Motor Omnibuses on English Railways

The North Eastern Railway is at present conducting experiments with motor omnibuses as a means of improving the services on certain branch lines on which circumstances do not permit an extension of traveling facilities of the usual kind. The omnibuses are of the ordinary road type and are fitted with flanged wheels. As a trial the first omnibus is being run on the line between York and Strensall. If the experiments are satisfactory, it is probable that the railway company will construct special omnibus vehicles for the purpose.

## National Safety Council

The eleventh annual Safety Congress of the National Safety Council will be held at Detroit, August 28 to September 1. The meetings will be held in the new Case Technical High School which has just been completed and contains an auditorium which will accommodate more than 3,000 persons. In connection with the convention a large safety exhibit will be held in the hall adjoining the main auditorium.

The Steam Railroad Section of which Isaiah Hale, safety superintendent, Atchison, Topeka & Santa Fe, is chairman, will hold its sessions on August 29 and August 30 at which a number of interesting papers will be presented.

## Death of Noted British Mechanical Officer

Norman J. Lockyer, locomotive works manager of the North Eastern Railway at Darlington, England, and one of Britain's best known railway mechanical men, died recently. Mr. Lockyer commenced his apprenticeship with Sir J. Whitworth & Co., Ltd., of Manchester, England, in 1877. Subsequently he served in the works of the Manchester, Sheffield & Lincolnshire Railway at Gorton until 1882, when he was employed by the running department. In 1885 he joined the staff of Sir A. M. Rendel, being employed in superintending the manufacture of locomotives for the Indian State and other railways. In 1896 he was appointed manager of the works of Sharp, Stewart & Co., Ltd., of Glasgow, the locomotive builders, and in 1899 he became works manager of the Gateshead Locomotive works of the North Eastern Railway. He was transferred to the Darlington works in 1909. He was the inventor of a number of devices for use on locomotives and in railway shops, one of the best known of his locomotive invention being called the "Lockyer" double-beat regulator valve.

## Pennsylvania Women's Aid

The Women's Aid of the Pennsylvania Railroad System is conducting a campaign to increase its membership among the families of the 17,000 employees in the Northwestern Region. The Women's Aid aims to organize the women of the families connected with the Pennsylvania System in order that they may know one another and, when occasion arises, render aid and sympathy in such manner as may be most helpful. It has now more than 50,000 members. The wives, mothers, sisters and daughters of Pennsylvania employees and all women employees are eligible for membership. The dues are uniformly 25 cents a year. The badge is a small pin inscribed "P. S. Women's Aid." Mrs. W. W. Atterbury is director of the Aid for the System, and Mrs. J. G. Rodgers is associate director for the Northwestern Region. The six operating divisions in the Northwestern Region have been organ-

ized under the following superintendents: Chicago Terminal, Mrs. W. H. Scriven; Fort Wayne, Mrs. T. A. Roberts; Logansport, Mrs. B. H. Hudson; Toledo, Mrs. J. B. Hutchinson, Jr.; Grand Rapids, Miss Hilda Jones; Mackinaw, Mrs. R. E. Casey.

### Adjustment of Brake Power on Tank Cars

Request has been received from a majority of the owners and operators of tank cars for an extension of the effective date for complying with the provisions of Circular S. III-11 of the Mechanical Division of the A. R. A., issued May 15, 1919, and the Tank Car Specifications for the Adjustment of Brake Power on Existing Cars. It is stated that this request is due to the general business conditions prevailing for some time and also to the fact that so many of the cars were scattered throughout the country, many of them having been stored on railroad sidings, making it difficult, if not impracticable, for the owners to complete the work in the time limit was set, which was July 1, 1921.

This request has been granted by the General Committee and the effective date for complying with the requirement of the Tank Car Specifications in the matter of Adjustment of Brake Power on existing tank cars is extended to July 1, 1923.

### Fuel Savings on the Pere Marquette

A letter by Frank H. Alfred, president and general manager of the Pere Marquette, addressed to all employees who have to do with the handling and consumption of fuel, calls attention to the excellent fuel performance obtained on that road during the month of April. Passenger, freight and switching records for that month show an improvement over March, 1922, and also a better showing than in the same month of 1921. The fuel performance in these periods was as follows:

	April, 1922	March, 1922	April, 1921
Passenger service			
Average car miles per ton of coal.....	117.30	109.00	111.10
Freight service			
Pounds of coal per 1,000 gross ton miles	144.00	148.87	187.64
Switching service			
Average miles per ton.....	14.19	13.47	14.21

The increase in the average car miles per ton for April, 1922, over March, 1922, is 7.61 per cent, and over April of last year, 5.58 per cent. In freight service the record shows a 3.29 per cent better performance in April than in March of this year and a 23.26 per cent better showing than for April of last year, this being in part due to the better quality of coal used.

### Labor Board Decisions

**PAY OF FOREMEN WHILE GANG IS LAID OFF.**—A case arose on the Buffalo, Rochester & Pittsburgh in connection with an extra gang that was laid off one day each week, the foreman contending that he was exempt from deductions from his monthly pay on this account. The decision of the board is that if the foreman is compensated on a monthly basis for all service rendered, including time worked in excess of the regular working hours or days assigned, he should receive not less than the monthly rate so established, provided he was ready and available. If on the other hand the foreman is compensated on the monthly basis but is paid overtime for work performed after eight hours and for all work performed on Sundays and holidays, no valid claim can be made for time lost under the provisions of Section 8, Article V, of the agreement.—*Decision No. 896.*

**SHEET METAL WORKERS IN M. W. DEPARTMENT INCLUDED IN SHOP CRAFTS.**—The Federated Shop Crafts brought before the Labor Board the cases of two employees in the maintenance of way department of the Northern Pacific who were working under the master carpenter, contending that these men should be classified as sheet metal workers and should be represented by the Federated Shop Crafts. Both men were rated as bridge carpenters, one doing tinner's work and the other pipe work in connection with water service. The road contended that these employees performed other mechanic's work as it was assigned to them from day to day. The Labor Board ruled that these men are sheet metal workers in the sense in which this term is commonly understood, and that they come properly under the jurisdiction of the Railway Employees' Department of the Federated Shop Crafts. Dissenting opinions were filed by J. H. Elliott and Horace Baker. In the dissenting opinions it is pointed out that these men have been employed in the bridge and building department for several years. The fact was also emphasized that the character of the work there and of that done in the locomotive department are entirely different and

that the line of demarcation between employment in these departments has long been kept distinct. In their opinion the ruling of the Labor Board will create confusion between the work of the two departments.—*Decision 946 and 947.*

### General Foremen's Convention

The International Railway General Foreman's Association has issued the following announcement of its 1922 meeting:

"The General Foreman's convention, scheduled at Chicago for September 5, 6, 7 and 8, 1922, affords an opportunity for a period of intensive instruction that no general foreman or his superior officer can consistently disregard.

"Held annually at a nearly central point in the United States and at a time of the year that is the most favorable for the average railway shop supervisor to absent himself from his duties, the attendance will comprise a class of energetic, earnest workers who will put vim into their meetings and return to their tasks broadened and advanced in their ideas.

"Insofar as the foreman has been the subject for a great many printed articles showing his acts to be commendable or otherwise, as the spirit of the writer impelled his ideas, it brings out this thought: Is the foreman to blame for his lack of knowledge or his apparent inability to keep step with the rapid progress of the railway mechanical department? If due consideration is given to the fact that four years of constant training is necessary to produce a passable mechanic, we would say that the foreman who rarely sees any shop except the one in which he is employed and meets no mechanical men other than his daily associates, is not to be censured but rather to be praised for what he does accomplish, and that the time spent at an annual convention or meeting yields large returns.

"Numerous men holding responsible positions today attribute their success and value to their employer largely to the broadening influence gained by attendance at business sessions. Each railway general foreman as a matter of benefit to the stockholders by whom he is employed, his superior officers, and himself should not only be permitted but required to attend the convention of the International Railway General Foreman's Association."

### Meetings and Conventions

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

- AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. 1923 annual convention; Denver, first Tuesday in May.
- AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borchardt, 202 North Hamlin Ave., Chicago.
- AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
- DIVISION V—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.
- DIVISION V.—PURCHASE AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio.
- AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.
- AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 2201 Woolworth Building, New York.
- AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.
- AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention and exposition postponed until October 2-7, 1922, Detroit, Mich.
- ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.
- CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meeting second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.
- CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago, Ill.
- CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koenke, 604 Federal Reserve Bank Building, St. Louis, Mo.
- CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Meeting second Thursday in January, March, May, September and November, Hotel Iroquois, Buffalo, N. Y.
- CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill. Annual convention August 22-24, Chicago.
- CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central building, Cincinnati, Ohio. Regular meetings second Tuesday, February, May, September and November.
- DIXIE AIR BRAKE CLUB.—E. F. O'Connor, 10 West Grace St., Richmond, Va.
- INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Convention Hotel Sherman, Chicago, August 15, 16 and 17.
- INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill.
- INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 5-8, 1922.
- MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

**NEW ENGLAND RAILROAD CLUB.**—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday each month except June, July, August and September, Copley Plaza Hotel.

**NEW YORK RAILROAD CLUB.**—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings third Friday of each month, except June, July and August, at 29 West Thirty-ninth street, New York.

**NIAGARA FRONTIER CAR MEN'S ASSOCIATION.**—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

**PACIFIC RAILWAY CLUB.**—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday of each month in San Francisco and Oakland, Cal., alternate.

**RAILWAY CLUB OF PITTSBURGH.**—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in each month, except June, July and August, at Fort Pitt Hotel, Pittsburgh, Pa.

**ST. LOUIS RAILWAY CLUB.**—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday each month, except June, July and August.

**TRAVELING ENGINEERS' ASSOCIATION.**—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

**WESTERN RAILWAY CLUB.**—Bruce V. Crandall, 14 E. Jackson Boulevard, Chicago. Regular meetings third Monday of each month, except June, July and August.

### Locomotive Orders

THE NEW YORK CENTRAL has ordered 100 locomotive boosters from the Franklin Railway Supply Company.

THE SOUTHERN PACIFIC has ordered 55 locomotive boosters from the Franklin Railway Supply Company.

THE NEW YORK, CHICAGO & ST. LOUIS has ordered 14 locomotives from the Lima Locomotive Works.

THE SOUTHERN RAILWAY has ordered 15 Mikado type locomotives from the American Locomotive Company.

### Freight Car Orders

THE PERE MARQUETTE has ordered 500 box cars from the Pressed Steel Car Company.

THE BALTIMORE & OHIO has ordered 1,000 box car bodies from the Standard Steel Car Company.

THE NEW YORK, CHICAGO & ST. LOUIS has ordered 400 refrigerator cars from the Merchants' Despatch.

THE TENNESSEE CENTRAL has ordered 350 gondola cars from the Western Steel Car & Foundry Company.

THE GRAND TRUNK has ordered 250 refrigerator cars from the National Steel Car Corporation, Hamilton, Ont.

THE BELT RAILWAY OF CHICAGO has ordered 100 hopper cars from the Western Steel Car & Foundry Company.

THE MISSOURI, KANSAS & TEXAS has ordered 200 refrigerator cars from the American Car & Foundry Company.

THE CHILE EXPLORATION COMPANY, New York City, has ordered 30 steel ore cars from the Pressed Steel Car Company.

THE FLORIDA EAST COAST has ordered 175 refrigerator cars from the Mount Vernon Car Manufacturing Company.

THE FORT SMITH & WESTERN has ordered 125 steel center constructions from the Western Steel Car & Foundry Company.

THE ATLANTIC COAST LINE has ordered 700 box cars of 40 tons' capacity from the Standard Tank Car Company, Sharon, Pa.

THE NEW YORK CENTRAL has ordered about 975, 55-ton all steel hopper car bodies from the American Car & Foundry Company.

THE FLORIDA EAST COAST has ordered 30 tank cars of 10,000 gal. capacity from the General American Tank Car Corporation.

THE BUFFALO & SUSQUEHANNA has ordered 200 hopper car bodies of 55 tons' capacity from the Standard Steel Car Company.

THE NEW YORK, CHICAGO & ST. LOUIS has ordered 1,000 automobile box cars from the Illinois Car & Manufacturing Company.

THE NEW YORK, CHICAGO & ST. LOUIS has ordered 100 steel center constructions from the Illinois Car & Manufacturing Company.

THE CHESAPEAKE & OHIO has ordered 500 ventilated box cars of 40 tons' capacity, from the Newport News Shipbuilding & Dry Dock Company.

THE MISSOURI, KANSAS & TEXAS has placed an order with the General American Car Company for 200 refrigerator cars of 40 tons' capacity.

THE UNION REFRIGERATOR TRANSIT COMPANY, Milwaukee, Wis., has ordered 350 refrigerator cars from the American Car & Foundry Company.

THE ROXANA PETROLEUM CORPORATION, St. Louis, Mo., has ordered 25 insulated tank cars of 40 tons' capacity from the General American Tank Car Corporation. The cars will hold 8,000 gal.

THE CHESAPEAKE & OHIO has arranged for the purchase of

300, 40-ton box cars in addition to the 1,400 already ordered as noted in the May issue of the RAILWAY MECHANICAL ENGINEER.

THE SEABOARD AIR LINE has ordered 900 steel underframe ventilated box cars of 40 tons' capacity from the Pressed Steel Car Company and 100 phosphate cars of 50 tons' capacity from the Magor Car Corporation.

THE NORTHERN PACIFIC has ordered 250 ballast cars from the Roger Ballast Car Company. The company has also placed an order for 1,000 automobile box cars and 250 stock cars with the General American Car Company.

THE ATCHISON, TOPEKA & SANTA FE has ordered 2,000 steel-underframe, double-sheathed box cars of 40 tons' capacity, as follows: From the Pullman Company, 1,000 cars; from the American Car & Foundry Company, 500 cars; and from the Standard Steel Car Company, 500 cars.

THE WABASH has ordered 2050 composite gondola car bodies of 50 tons' capacity from the General American Car Company, and 750 steel underframe automobile cars, 40 ft. in length and 40 tons' capacity, from the American Car & Foundry Company and 750 from the Pullman Company.

THE BALTIMORE & OHIO has ordered 1,000, 70-ton low-side gondola cars from the Cambria Steel Company, and will have repairs made to 1,000 gondola cars and 1,000 hopper cars at the shops of the Pressed Steel Car Company; also to 1,000 coke cars at the shops of the Standard Steel Car Company.

THE NEW YORK CENTRAL has ordered 1,106 self clearing hopper cars of 55 tons' capacity from the American Car & Foundry Company, 18 low side gondola cars of 70 tons' capacity from the Standard Steel Car Company and 49 high side gondola cars of 50 tons' capacity from the Buffalo Steel Car Company.

### Freight Car Repairs

THE BALTIMORE & OHIO is having repairs made to 25 refrigerator cars at the shops of the Standard Steel Car Company and to 25 at the shops of the American Car & Foundry Company, and 25 coke cars at the shops of the Koppel Car Repair Company.

THE ERIE has awarded contracts for the repair of the following cars: 1,000 box and 100 refrigerator cars to the Standard Steel Car Company; 1,500 to the Illinois Car Company; 1,000 to the Buffalo Steel Car Company; 1,000 to the Youngstown Steel Car Company, and 500 to the Western Steel Car & Foundry Company.

THE ILLINOIS CENTRAL has contracted with the Streater Car Company for repairs to 1,300 automobile box cars; with the Interstate Car Company for 500 box cars; with the Illinois Car Company for 300 steel general service cars; with the Ryan Car Company for 600 steel general service cars, and with the Pullman Company for 800 box cars. The company will also repair 500 cars in its Burnside shops.

### Passenger Car Orders

THE MISSOURI, KANSAS & TEXAS has ordered 30 steel passenger coaches from the American Car & Foundry Company.

ST. LOUIS-SAN FRANCISCO has ordered 6 steel chair cars and 8 steel coaches from the American Car & Foundry Company.

THE ATLANTIC COAST LINE has ordered 20 express cars and 10 coaches from the Bethlehem Shipbuilding Corporation, Harlan Plant.

### Machinery and Tools

THE LONG ISLAND is inquiring for 2 axle lathes, a wheel press and some other machines.

THE DETROIT UNITED RAILWAY has ordered a 36-in. lathe from the Niles-Bement-Pond Company.

THE BOSTON & ALBANY is inquiring for a 90-inch wheel lathe, also for a box facing and boring machine.

THE WHEELING & LAKE ERIE has ordered one 48-in. car wheel borer from the Niles-Bement-Pond Company.

THE SOUTHERN PACIFIC has ordered a 15-ton crane with 75 ft. span from the Niles-Bement-Pond Company.

THE SOUTHERN PACIFIC has ordered a 200-ton overhead traveling crane from the Niles-Bement-Pond Company.

THE DELAWARE & HUDSON has ordered a 42-in. center drive car wheel lathe from the Niles-Bement-Pond Company.

THE WAR DEPARTMENT is offering for sale a large list of commodities, including machine tools, shop equipment and supplies.

THE CAMBRIA & INDIANA has ordered a 79-in. driving wheel lathe and a thirty-six-inch planer from the Niles-Bement-Pond Company.

THE SOUTHERN PACIFIC has ordered a 200-ton locomotive lifting crane of 77 ft. span, and a 15-ton overhead crane of 75 ft. span, from the Niles-Bement-Pond Company.

THE UNION PACIFIC has prepared a machine inquiry list consisting of 73 items which are as follows: 22 lathes of various types, 15 grinders of various types, 4 boring bars, 4 drills, 3 boring mills, 2 drill presses, 2 shapers, 2 forcing presses, 2 pneumatic flanging machines, 1 boring and turning machine, 1 disk sander, 1 flange clamp, 1 punch and shear, 1 riveting machine, 1 hammer, 1 boring machine, 1 centering machine, 1 slip roll forming machine, 1 pipe folder, 1 pneumatic flanging clamp, 1 pipe cutting and threading machine and 1 cutting off machine.

THE CHICAGO, BURLINGTON & QUINCY has issued a new machinery inquiry for its Denver shops covering 117 items which include 31 lathes of various types, 19 grinders of various types, 12 drills, 6 hammers, 5 presses, 5 crank shapers, 5 boring mills, 4 grindstones, 3 planers, 2 slotters, 2 turret screw machines, 2 bar iron shears, 2 combination punch and shears, 2 milling machines, 2 head bolt cutters, 2 pipe threading machines, 1 single end punch, 1 bolt centering machine, 1 bending roll, 1 pneumatic flanging machine, 1 pneumatic flanging clamp, 1 sheet metal cutter, 1 drill press, 1 forging machine, 1 staybolt and crownstay machine, 1 pipe bending machine and 1 horizontal boring machine.

### Shop Construction

ERIE.—This company has awarded a contract for an extension to its shops at Hornell, N. Y., to the Bates & Rogers Construction Company.

WABASH.—This company has awarded a contract to C. W. Gindle, Chicago, for the construction of a reclamation plant at Decatur, Illinois.

CHICAGO & NORTH WESTERN.—This company has awarded a contract to C. W. Gindle, Chicago, for the rebuilding in the near future of its 12-stall engine house at Ashland, Wis.

WESTERN MARYLAND.—This company has awarded a contract to the M. A. Long Company, Baltimore, for the erection of a 100 ft. by 300 ft. Mallet locomotive repair shop at Port Covington, Baltimore. The shop will be fully equipped with cranes and other machinery.

ATCHISON, TOPEKA & SANTA FE.—This company has authorized the construction of a new boiler and tank shop at Albuquerque, N. M., to cost approximately \$400,000; also the construction of boiler washing plants at Amarillo, Texas, and Winoka.

KANSAS CITY SOUTHERN.—This company is now preparing plans for and expects to undertake in the near future with its own forces, improvements to its shop at Pittsburg, Kan., which will consist principally of erecting 160-ft. and 110-ft. extensions to the present structure to provide facilities respectively for additional erecting space and for a blacksmith shop, and a 64-ft. extension to the present transfer table. The building will have a concrete foundation, brick walls with wire glass in metal sash, and composition roofing supported on steel trusses. Each of the six bays in the extensions to the erecting shop will be provided with engine pits to be served by a 10-ton and a 250-ton traveling crane. The work will cost approximately \$200,000.

### Bad Order Cars

The Car Service Division of the American Railway Association reported 327,704 bad order cars, or 14½ per cent, for the two weeks ending May 1. On June 1 the percentage of bad-order cars was 15 as compared with 14.7 on May 15.

### Freight Car Loading

According to the reports of the Car Service Division of the American Railway Association, freight car loading during the week ended May 13 continued to increase. The total, 777,359 cars was 26,173 more than the loading for the corresponding week of 1921 and an increase of 23,000 as compared with the week before.

For the weeks ended May 20, 27 and June 10, the totals were 792,459, 821,121 and 846,002 cars. For the corresponding weeks of last year 770,991, 795,335 and 787,283 loaded cars were reported.

## PERSONAL MENTION

### GENERAL

S. B. RILEY has been appointed superintendent of motive power of the Western Maryland with headquarters at Hagerstown, Md., succeeding G. F. Wieseckel, resigned.

J. P. ROQUEMORE, acting superintendent of motive power of the International & Great Northern since May 9, and prior to that mechanical engineer of the same company, has been appointed superintendent of motive power. L. E. Temple has been appointed mechanical engineer.

### PURCHASING AND STORES

B. W. GRIFFITH has been appointed general storekeeper of the Michigan Central with headquarters at Detroit, Mich., succeeding G. T. Dunn, resigned.

A. H. LARET has been appointed assistant to the vice-president and chief purchasing officer of the St. Louis-San Francisco with headquarters at St. Louis, Mo.

G. H. PINION has been appointed purchasing agent of the Trans-Mississippi Terminal with headquarters at Dallas, Texas, succeeding L. M. Sullivan, deceased.

C. R. PAINTER has been appointed assistant to the general purchasing agent of the New York, New Haven & Hartford with headquarters at New Haven, Conn., succeeding B. L. Northam, resigned.

R. J. AUL, storekeeper of the Indiana Harbor Belt, with headquarters at Gibson, Ind., has been appointed to serve also as storekeeper of the Chicago River & Indiana and the Chicago Junction.

J. E. BOLLINGER, secretary to the manager of purchases of the American Short Line Railroad Association, has been appointed assistant to the manager of purchases with headquarters at Washington, D. C.

W. McMASTER, purchasing agent of the Indiana Harbor Belt, with headquarters at Chicago, has been appointed purchasing agent also of the Chicago River & Indiana and the Chicago Junction, with headquarters at Chicago, in which capacity he succeeds S. Salter, heretofore purchasing agent of the Chicago Junction.

### MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

N. C. FERGUSON has resumed duty as road foreman of engines of the Dauphin Division of the Canadian National, with headquarters at Dauphin, Man., succeeding P. Henze.

G. L. FLINT has been appointed road foreman of engines of the Portland division of the Southern Pacific, with headquarters at Portland, Ore., succeeding E. Stroud, promoted.

P. HENZE has been appointed acting road foreman of engines of the Canadian National, with headquarters at Prince Albert, Sask., succeeding J. G. Norquay who has been granted a leave of absence.

F. C. SIMPSON, master mechanic of the Southern with headquarters at Bristol, Va., has been transferred in a similar capacity to Knoxville, Tenn. M. D. Stewart succeeds Mr. Simpson at Bristol.

M. L. ZYDER, roundhouse foreman of the Indiana Harbor Belt, has been promoted to assistant master mechanic at Gibson, to succeed A. B. Fromm, promoted to master mechanic to succeed C. B. Nelson.

What is described as probably the thickest seam of black coal discovered in any part of the world is being developed at Blair Athol, in Queensland. The maximum thickness, as far as can be ascertained, is 93 ft. The amount of coal in the field is estimated at 258,000,000 tons.

## OBITUARY

**I. B. LESH**, general superintendent of the Railway Materials Company, Chicago, with headquarters at Toledo, Ohio, died in that city on May 22.

**WILLIAM C. ARP**, retired superintendent of motive power of the Vandalia, died at his home in Terre Haute, Ind., on June 16 at the age of 74 years after having been engaged in railway service for 48 years.

**EDWARD A. WILLIAMS**, at one time general mechanical superintendent of the Erie, died at his home in Glen Ridge, N. J., on April 29. Mr. Williams was born at Wiscasset, Me., on October 4, 1848. He attended public school at Milwaukee, Wis., and learned the machinist trade in the Milwaukee shops of the Chicago, Milwaukee & St. Paul. From 1877 to 1880 he was round-house foreman for this road at Prairie du Chien, Wis., and thereafter, until 1886, general foreman at Wells, Minn. From 1886 to 1890 he was assistant general master mechanic at Milwaukee. Then, until 1893, he was master mechanic of the Minneapolis, St. Paul & Sault Ste. Marie with headquarters at Minneapolis. He was then promoted to mechanical superintendent, which position he left in 1901 to become superintendent of rolling stock of the Canadian Pacific with headquarters at Montreal. In 1904 and 1905 he was assistant general manager of the Erie and in November, 1905, became general mechanical superintendent, in which position he served until the time of his retirement in 1907.



E. A. Williams

**E. F. NEEDHAM**, formerly superintendent of motive power of the Wabash, died on May 18 in Boston, Mass. Mr. Needham was born at Batavia, Ohio, on December 25, 1864, and entered railway service in 1880

as a repair track laborer on the Wabash at Butler, Ind. Shortly thereafter he became a boilermaker apprentice at the Fort Wayne, Ind., shops, and at the conclusion of his apprenticeship in 1894, was promoted to foreman of the boiler shops at Fort Wayne. He was transferred to Springfield, Ill., as boiler foreman in January, 1899, was advanced to assistant master mechanic with headquarters at Decatur, Ill., on December, 1901, and held this position at Decatur and, after April, 1902, at Ashley, Ind., until October, 1902, when he was promoted to master mechanic with headquarters at Fort Wayne, Ind., having supervision over the Detroit, Peru and Buffalo divisions. He was transferred to Springfield, Ill., as master mechanic in charge of the Decatur and Springfield divisions in March, 1906, and on September 1, 1907, became superintendent of motive power, a position he held until June 1, 1920, when he resigned on account of ill health.



E. F. Needham

Work is progressing on the extension of the Canadian Pacific line from Kipawa to Les Quinze, at the further end of Lake Temiskaming. 800 men being employed. The line penetrates a fine agricultural area.

## SUPPLY TRADE NOTES

**A. L. Pearson**, secretary of Mudge & Co., Chicago, has been appointed assistant to the president in addition to his secretarial duties.

**J. D. Rogers**, who has been representing the Baldwin Locomotive Works in South Africa, has been appointed manager of the company's office at Calcutta, Ind.

**F. S. Wilcoxon**, formerly system fuel supervisor of the Chicago Great Western, has joined the service department of the Edna Brass Mfg. Company, Cincinnati, Ohio.

**G. H. Kilborn** has been appointed road foreman of engines of the Portland division of the Southern Pacific, with headquarters at Roseburg, Ore., succeeding G. L. Flint.

The Austin Company, Cleveland, Ohio, has been given a contract to put up a one-story building, 120 ft. by 400 ft., at Hammond, Ind., for the Standard Steel Car Company.

**N. R. Seidle** has resigned as assistant general manager of the Charles G. Heggie Company, Joliet, Ill., to become works manager of the General Boilers Company, Waukegan, Ill.

**Newcomb Carlton**, president of the Western Union Telegraph Company, has been elected a director of the United States Rubber Company, New York, to succeed Col. Samuel P. Colt, deceased.

**A. D. Halpern**, who has been associated with the Philadelphia sales staff of the Combustion Engineering Corporation, New York, for some time, has now become a member of its New York sales force.

**Harry B. Snyder**, who recently returned from the foreign branch service of the Baldwin Locomotive Works, has been appointed assistant to the president of the Pilliod Company, 30 Church street, New York City.

The Carborundum Company, Niagara Falls, N. Y., has appointed the American Abrasive Metals Company, 50 Church street, New York, to act as United States sales representative for the Carborundum anti-slip tile.

**J. W. McCabe** has been appointed manager of the St. Louis branch of the Chicago Pneumatic Tool Company. Mr. McCabe has been connected with that company for 20 years and has recently returned from a three years' business trip around the world.

The National Bronze & Aluminum Foundry Company, Cleveland, Ohio, is building an addition of 150 ft. to its new plant at East Eighty-eighth street and Laisy avenue, and is in the market for a few molding machines and some miscellaneous foundry equipment.

**Charles M. Schwab**, chairman of the board of directors of the Bethlehem Steel Corporation, has been elected chairman of the board, also of the Chicago Pneumatic Tool Company, New York, to succeed John R. McGinley, who resigned as chairman but who remains as a director of the company.

The Black & Decker Manufacturing Company, Baltimore, Md., has established a new Detroit office in the General Motors building in that city. **C. G. Odell**, assistant to the president of this company, will make this office his headquarters, in addition to which it will provide headquarters for the local Detroit representative.

The Fibre Conduit Company, Orangeburg, N. Y., has acquired the plant of the American Fibre Conduit Corporation, at Fulton, N. Y., and the conduit manufacturing business of the Johns-Mansville, Incorporated, at Lockport, N. Y., and has appointed Johns-Mansville, Incorporated, New York, as sales agent for its products.

**Frank Phalen**, manager of sales of the New York district for the Republic Iron & Steel Co., for the past 15 years, has resigned to associate himself with his brother Charles G. Phalen in the firm of Phalen & Co., 342 Madison avenue, New York City. This firm handles railway equipment and specialties, also iron and steel products.

The United Alloy Steel Corporation, Canton, Ohio, recently bought the Canton Sheet Steel plant. The plant will have a

capacity of around 60,000 tons of ingots a month. This company's products now include common and alloy steel, blooms, slabs, billets, plates, bars, rods, sheets and anti-corrosive Toncan iron.

O. H. Dallman, formerly with the Vanadium Alloy Steel Company, Latrobe, Pa., and the mechanical department of the Pennsylvania Railroad at its Fifty-fifth street shops, Chicago, has joined the sales force of the Independent Pneumatic Tool Company, Chicago.

Joseph H. Perry, Jr., has been appointed Philadelphia representative of the Edgewater Steel Company, Pittsburgh, Pa. Mr. Perry will have his office in the Finance building. He was for a number of years with the engineering department of the Pennsylvania Railroad at Pittsburgh. M. Roy Jackson, who was formerly vice-president in charge of the Philadelphia office, has resigned.

A. R. Ludlow, vice-president in charge of sales of the Air Reduction Company, Incorporated, New York, has been elected first vice-president; M. W. Randall, secretary, has been elected vice-president and secretary; Herman Van Fleet, chief engineer, has been elected vice-president and operating manager and Dr. F. J. Metzger has been elected vice-president in charge of research and development.

The E. H. Welker Company, Inc., 222 W. Larned street, Detroit, Mich., will in the future represent the George Oldham & Son Company, Baltimore, Md., in the state of Michigan and the city of Toledo, Ohio, and J. A. Meredith will represent this company in the Pittsburgh district with office at 2138 Oliver building. Both the Detroit and Pittsburgh offices will be factory branches and will carry in stock a complete line of the company's pneumatic equipment.

Wesley W. Burden, formerly with the Bird-Archer Company as chief mechanical engineer and assistant to the president, has resigned to become vice-president and treasurer of the Wilbur G. Hudson Corporation, engineers and constructors, with offices at 50 Church street, New York. This company specializes in coal, coke, ash, and ore handling systems, steel, timber and reinforced concrete structures, railroad shops, roundhouses, terminals, and railroad coaling stations.

Ralph Templeton, for several years manager of the Whitman & Barnes Manufacturing Company's New York office and store, has assumed an important position in the company's executive offices in Akron, Ohio. Mr. Templeton entered the employ of the Whitman & Barnes organization in 1898 and has served it in various capacities continuously since that time. He was at first in the Akron office, then Detroit representative, and since 1910 manager of its New York store.

J. M. Kryl, president of the Kryl Bridge & Crane Works, Chicago, and W. H. Eichelman, until recently chief engineer of the Hamler Boiler & Tank Company, Chicago, have formed a partnership under the name of Kryl & Eichelman at 2906 West Twenty-sixth street, Chicago. Both men are graduate engineers of considerable experience in fabricating steel plate and structural iron with present facilities for handling water tanks, oil tanks, stacks, process kettles of all kinds for chemical equipment, ornamental iron and structural steel.

Harry M. Wey has been appointed manager of the Chicago district for the Pittsburgh Testing Laboratory, Pittsburgh, Pa. Mr. Wey's office is at 1560 Monadnock block. He entered the service of the Pennsylvania Railroad in 1900 in the office of the superintendent of motive power at Columbus, Ohio. Later he served in the motive power departments of the Illinois Central and the Atchison, Topeka & Santa Fe. He was again employed in the mechanical department of the Pennsylvania, Lines west of Pittsburgh, from 1905 until 1909 when he entered the sales department of the U. S. Metallic Packing Company.

C. E. Meyer has been placed in charge of railway sales of the railroad department recently organized by the Parish & Bingham Corporation, Cleveland, Ohio. This new department has been formed for the purpose of manufacturing pressed steel car parts and other railway specialties. P. O. Krehbiel, a former engineer of the same corporation, has been appointed chief engineer of the railroad department. Mr. Meyer started in the railway supply business in 1911 with the National Malleable Castings Company at Cleveland. He left the employ of that company in February, 1913,

to enter the stores department of the Damascus Brake Beam Company, Cleveland. With the exception of eighteen months in the military service in this country and in France, he has been in the continuous service of the latter company in its purchasing, operating and sales departments until his recent appointment as above noted.

The Pittsburgh Testing Laboratory, Pittsburgh, Pa., has opened a sales office with a complete inspection bureau, at 1864 Railway Exchange building, St. Louis, Mo., and has appointed Colonel N. C. Hoyles as district manager. He is a graduate of Queens University, and took a post-graduate course at the University of Toronto. In 1908 he entered the service of this company as an inspector at its Birmingham office and in 1912 was promoted to manager of that office. Two years later he was transferred to the Vancouver office; and at the breaking out of the war, he entered the service of the Canadian Army, serving with the British Pioneer Engineers Corps in France. He received decorations from both the French and British governments, and upon his release from the Army in 1919, he was appointed assistant sales manager at Cleveland. Since that time he has been consecutively assistant sales manager at New York and manager at Cincinnati, until his appointment to the new position above mentioned.

At a meeting of the board of directors of the Joliet Railway Supply Company held in Chicago last week, Burton Mudge and Fred A. Poor were elected directors. Burton Mudge was elected president to succeed Frederick L. Sivyver, who remains as a director. Messrs. Mudge and Poor have acquired a controlling interest in this company, but Mr. Sivyver and his associates and the Northwestern Malleable Iron Company will continue to hold a substantial interest in the company and will be represented on its board. Mr. Mudge states that this is a preliminary step in the reorganization of the business and in the enlargement of the personnel and facilities of the company to handle properly its growing business. He adds that there will be no change in the direct management of the business, James H. Slawson, first vice-president, continuing as heretofore in charge of manufacturing and all other departments, and Charles A. Carscadin, vice-president in charge of sales. The company owns and operates a steel fabricating plant in Chicago where it manufactures car truck bolsters and brake beams. Its general offices are in the Railway Exchange, Chicago.

J. M. Duncan, whose selection as general sales manager of the Detroit Steel Casting Company, with headquarters at Detroit, Mich., was announced in the June issue of the *Railway Mechanical Engineer*, was born at Toronto, Canada, on February 22, 1888. Mr. Duncan entered the railway supply field on November 27, 1905, in the employ of the Detroit Steel Casting Company. He was later made "follow-up engineer" of this company, in which position he personally followed every important shipment to its destination to see how the castings were applied, and to ascertain whether more satisfactory results could be obtained by closer co-operation between the management and the user. He was serving in this capacity at the time of his recent promotion to general sales manager.

William H. Eager, since 1918 first vice-president of the Whitman & Barnes Manufacturing Company, Akron, Ohio, has been elected president to succeed A. D. Armitage, who resigned on June 7, in order to give more of his time to his duties as vice-president and general manager of the J. H. Williams Company, Brooklyn, N. Y., with executive offices in Buffalo. Mr. Armitage still remains a member of the Whitman & Barnes board of directors. Mr. Eager is a graduate of the Massachusetts Institute of Technology, and for the past 16 years has been with the Whitman & Barnes Manufacturing Company, having joined



J. M. Duncan

the organization as assistant superintendent of its Chicago factory, later becoming works manager and in 1908 he was elected treasurer. In the early part of 1909 he was transferred to Akron, two years later he was appointed sales manager, and in 1918 was elected first vice-president. Frank W. Oliver has been appointed eastern sales manager of the Whitman & Barnes Manufacturing Company, with headquarters at 64 Reade street, New York City. Mr. Oliver has been connected with the drill and reamer industry continuously for 23 years.

Philip L. Maury has been elected a vice-president of the Detroit Graphite Company with headquarters at Detroit, Mich. He will have direct charge of all activities of the company pertaining to its paint and varnish business with railroads.



P. L. Maury

Mr. Maury was born in Denver, Colo., on October 5, 1884. After leaving school he entered the paint business and has been connected with that industry ever since, having served for many years with the Sherwin-Williams Company as manager of railway and industrial sales, which position he leaves to take up his new duties with the Detroit Graphite Company. During the war he was in charge of the government activities of the Sherwin-Williams Company and was closely identified with the

work of the War Service Committee of the Paint Manufacturers' Association.

Elliott E. Nash, vice-president and general manager of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn., has resigned to become western representative of the

American Locomotive Company, with headquarters at Chicago. Mr. Nash was born on March 28, 1870, at Hudson, Wisconsin, and entered railway service in June, 1886, with the Chicago, St. Paul, Minneapolis & Omaha, where he served in various clerical capacities until November, 1888, when he became traveling auditor, with headquarters at St. Paul. He was appointed agent in March, 1892, and continued in this capacity at Ashland, Wis., at St. Paul, Minn., and at Minneapolis, until January, 1905, when he was promoted



E. E. Nash

to assistant superintendent at Itasca, Wis., being transferred later to Eau Claire. In May, 1910, he entered the service of the Chicago & North Western at Chicago with a special assignment in the president's office, where he remained until May, 1911, when he was promoted to superintendent at Winona, Minn., where he remained until April, 1912, when he was transferred to Baraboo, Wis. In November, 1913, he was promoted to assistant general superintendent of all lines east of the Missouri river except the Iowa, Minnesota and Dakota divisions, and in October, 1917, he was transferred to the Iowa territory, with headquarters at Boone, Iowa, where he remained until July, 1918, when he was promoted to assistant to the federal manager, which position he held until March, 1920, when he became general manager of the Minneapolis & St. Louis with headquarters at Minneapolis, Minn. He was promoted to vice-president and general manager of this company on May 31, 1921.

The Paige & Jones Chemical Company, New York, manufacturers of materials for treating boiler feed water, has opened a general sales office at 417 South Dearborn street, Chicago. Lucius A. Fritze, until recently vice-president and general sales manager of the Borromite Company, who is a practical chemist and has had an extended experience with various phases of feed water treatment, has become associated with the Paige & Jones Chemical Company as vice-president and general sales manager, with headquarters at Chicago, and Robert O. Friend, formerly water and mechanical engineer of the Borromite Company, who is experienced in designing and building water softening plants, has been appointed vice-president and supervising engineer with headquarters at Hammond, Ind., of the Paige & Jones Chemical Company. The other officers of the company are: Fred O. Paige, president; Charles P. Wolfe, vice-president and treasurer, both at New York; Fred O. Paige, Jr., secretary and works manager, Hammond, Ind. The executive offices of the company are at 248 Fulton street, New York, and the technical department works are at Hammond. C. B. Flint will continue as sales manager of the railroad department, with headquarters at New York.

### General Electric Elects Two New Vice-Presidents

J. G. Barry, sales manager of the General Electric Company since 1917, and manager of its railway department for many years, and A. H. Jackson of the law department, were

recently elected vice-presidents of the company at a meeting of the board of directors.

Mr. Barry has been connected with the General Electric and Thomson-Houston Companies for 32 years and is 52 years old. He was first employed in the production department of the Thomson-Houston Company in Lynn, in 1890. A year later he was transferred to the construction department of the Boston office and in 1894 entered the railway department at Schenectady, following the organization of the General Electric Company. Mr. Barry

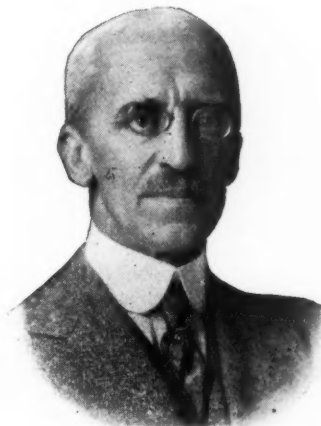
worked up to the position of assistant manager of this department in three years, and in 1907 was appointed manager in which position he exerted a marked influence on many aspects of the company's sales problems and policies. His success as manager of the railway department, one of the most important divisions of the G-E organization, led to his appointment in 1917 as general sales manager and his present promotion to vice-president.

Mr. Jackson has been head of the law department of the General Electric Company for several years. He was born in Schenectady in 1864 and was educated in the public schools there. In 1886 he was graduated from Union College and two years later received the degree of LL.D. from the Albany Law School. He first practised law

with his father, Judge Samuel W. Jackson, and remained with him until 1902, except for three years which he spent with the firm of Chanler, Maxwell and Philip in New York. Mr. Jackson was first employed at the General Electric Company in the law department in December, 1902.



J. G. Barry



A. H. Jackson

John F. Schurch, vice-president of the T. H. Symington Company, with office at St. Paul, Minn., has left that company and has been elected a vice-president of Manning, Maxwell & Moore, Inc., New York. He will be in charge of sales in the middle west and west, with headquarters at Chicago, 27-29 North Jefferson street. Mr. Schurch was graduated from the University of Minnesota in 1893. He entered the service of the Minneapolis, St. Paul & Sault Ste. Marie the same year, serving consecutively in the office of the auditor and of the general superintendent and in the transportation department, resigning in 1905 after having attained the position of chief clerk to the vice-president. From 1905 until 1914 he was associated with the Railway Materials Company of Chicago. In February, 1914, he was elected vice-president of the Damascus Brake Beam Company with office in Cleveland, Ohio, and in June, 1914, he was elected president of the same company, which position he resigned the same year and was elected vice-president in executive charge under President T. H. Symington, of the Symington Company. Mr. Schurch was president of the Railway Supply Manufacturers' Association, which had in charge the exhibits at Atlantic City in connection with the meetings last month of Division V—Mechanical, and VI—Purchases and Stores, A. R. A.



J. F. Schurch

#### Changes in Baldwin Personnel

Several changes in the official personnel of the Baldwin Locomotive Works were made recently; J. P. Sykes, vice-president in charge of manufacture, has been appointed senior vice-president in charge of plant and manufacture; C. A. Bourgeois, works manager, has been appointed vice-president in charge of manufacture; J. L. Vauclain, in the plant and equipment department, has been appointed vice-president in charge of plant and equipment. Harry Glaenzer, chief mechanical engineer, has been appointed vice-president in charge of engineering, to succeed Kenneth Rushton, deceased, and W. A. Russell, purchasing agent, has been appointed vice-president in charge of purchases.

#### Federal Trade Commission Opposes Steel Merger

The Federal Trade Commission has issued a formal complaint against the Bethlehem Steel Corporation and the Lackawanna Steel Company charging that the merger of the two companies will constitute an unfair method of competition in that it contains a dangerous tendency unduly to hinder competition and restrain commerce.

#### New Merger of Three Steel Companies

Announcement is made of the adoption of a plan by which the properties of the Midvale Steel & Ordnance Company, the Republic Iron & Steel Company, and the Inland Steel Company will be unified in the ownership of the Midvale Steel Company, whose name will be changed to the North American Steel Company, or some other appropriate name. The terms of the plan are as follows: All existing obligations of the three companies are to be assumed by the unified company. Existing preferred and common stocks will be changed into preferred and common stocks of the unified company. The new preferred stock is to have a par value of \$100 per share, is to be 7 per cent cumulative, is to be redeemable at \$115 per share and accrued dividends and is to be convertible for twelve years into new common stock at the rate of five shares of new common for four shares of new preferred. The common stock is to be without par value.

All assets of the three companies are to be owned by the unified company, except the Nicetown plant (the armor-making, ordnance and forging plant) of the Midvale Steel Company, which is to be transferred to a separate company with a capital of 500,000 shares without par value.

## TRADE PUBLICATIONS

**VISES.**—The Charles Parker Company, Meriden, Conn., has issued catalogue No. 57, also three-fold circulars showing its line of vises and their many features in complete detail.

**PNEUMATIC TOOLS.**—Master pneumatic tools and their various parts are listed and illustrated in a catalogue of spare parts prices recently issued by William H. Keller, Inc., Grand Haven, Mich.

**RESISTANCE THERMOMETRY.**—The Brown Instrument Company, Philadelphia, Pa., has published a new resistance thermometer catalogue which explains the theory of resistance thermometry, the various types of instruments which are made and the merits of each type.

**PIG IRON.**—The Bethlehem Steel Company, Bethlehem, Pa., has issued an interesting, illustrated booklet of 28 pages describing Mayari pig iron, a low phosphorus and low sulphur iron, containing also nickel, chromium and small percentages of titanium and vanadium. Analysis specifications of castings made with Mayari iron for special purposes are also included.

**AUTOMATIC APPLIANCES.**—The Imperial flange oiler, automatic grease plug and drain valve and valve system are described and shown in detail in cross-sectional views in catalogue No. 1 recently issued by the Imperial Steam Appliance Company, Seattle, Wash. "Don'ts" referring to the grease cup and questions relative to the automatic drain system are interesting features of the catalogue.

**INDUSTRIAL FURNACES.**—The Surface Combustion Company, New York, is issuing a series of bulletins, Nos. 3-D, 5, 6, 7, 8, 16, 17, 18 and 24, pertaining to low-pressure air-gas inspirators, oven furnaces for the heat treatment of both carbon and high speed steel, pot-hardening furnaces, soft metal furnaces, galvanizing baths, shipyard furnaces, rivet heaters, small forges and laboratory furnaces for high temperatures, respectively.

**WELDED FLEXIBLE STAYBOLTS.**—A pamphlet outlining the reason why locomotive users should change from the threaded to the welded flexible staybolt sleeve in their boilers has been sent out by the Flannery Bolt Company, Pittsburgh, Pa. The answer given in the booklet is that the latter is stronger, will not leak, does not require the care in application, will not crystallize and can be used to replace threaded sleeves or rigid bolts.

**BOILER FEED WATER REGULATOR.**—"Regulating Boiler Feed Water" is the title of a booklet which has recently been published by the Northern Equipment Company, Erie, Pa. The subject has been treated in an entirely new way, the object being to cover boiler feed water regulation completely and yet very briefly. To accomplish this purpose, free use has been made of a graphical method of presentation: charts showing the effect of feed water regulation on water input, steam output, feed water temperatures, etc.; also other charts, photographs, etc.

**BOILER TUBE CORROSION.**—Three authoritative articles on the subject of boiler tube corrosion, each of which is written from the particular and definite viewpoint of either the locomotive, the stationary, or the marine engineer, have been selected and incorporated as the basis of Bulletin No. 4-C issued by the National Tube Company, Pittsburgh, Pa. The combined information in the bulletin, which is entitled, "Preventing Corrosion of Boiler Tubes," gives the more important data available on the problems involved and, taken individually, each article reflects the main accomplishments of research in their respective fields.

**STAYBOLTS AND STAYBOLT SLEEVES.**—The American Locomotive Company, New York, has recently issued catalogue No. 10.050-A describing its new line of staybolts and staybolt sleeves. These include reduced body flexible bolts, reduced body rigid bolts, tapered end crown stays and Alco welded sleeves and caps. The staybolt sleeves are made with square ends seating on the sheet, tapered ends to fit into the holes reamed in the sheet and a flush type in which the sleeve has a very slight projection above the sheet. Special hexagon caps have been designed for these sleeves which permit easy application or removal and keep the projections beyond the outer sheet at a minimum.